I. INTRODUCTION AND RESOURCE BASE

Ethiopia has diverse agro-climatic conditions, vast resources in livestock and a high human population, which necessitates the introduction of appropriate interventions to enhance productivity for increased food production to satisfy nutritional self-sufficiency and national economic development.

The agricultural sector, engaging 80% of the population, contributes 52% of the Gross Domestic Product (GDP), 90% of the foreign exchange and provides 75% of raw material (MOA, 1996). The output from the livestock sub sector, on the other hand, accounts for 18% of the national economy, 40% of the agricultural sector and 31% of total employment. As per the National Account estimates of agricultural value added the respective share of cropand livestock accounts for 60% and 27% while forestry and the remaining others contribute 13% (MOA, 2000).

The present human population of 67.2 million (2002) is expected to grow to 73 million by the year 2005 and subsequently will double the 1995 population by 2020. The rural to urban ratio will also continue to change and be increased in favor of urban population in the coming 25 years. The current rural and urban distribution of 84.7% and 15.3% will gradually reach 80.11% and 19.89% (2020) with respective growth rates of 1.68% and 3.51% per year (CSA, 1996). Vulnerable groups (aged up to 14) will account for 34% of the population, which emphasises the growing importance of milk supply. Distribution and growth rate of rural and urban population of the country in the coming 15 years is indicated in Table 1.

Table 1: Human population distribution and growth rate for years 2000-2020

Population	Year					
	1995	2000	2005	2010	2015	2020
Distribution (%)						
Rural	86.02	85.08	84.00	82.80	81.51	80.11
Urban	13.98	14.92	16.00	17.20	18.49	19.89
Growth rate (%)						
Rural	2.74	2.57	2.35	2.15	1.98	1.68
Urban	4.38	4.0	4.06	3.88	3.69	3.51

Source: CSA, 1998

Despite the 66% potentially identified agricultural land, only 73,620,360 hectares (22.4% of the potential and 14.8% of the total) is under cultivation and the rest (77.6%) is under various forms of grazing (MOA, 1996). Two distinct ecological categories, highland and lowland, characterizes the country's agricultural and livestock production system. The highlands comprises 40% of the country's land area, holds 88% of the human and 74 % of the tropical livestock units (TLU). The main activity is a mixed farming system dominated by crop production and accounts for more than 90 % of the country's economic activity (Constable, M. et al. 1989). The highland area based on the development potential and resource base is further defined under three zones, the high potential cereal/livestock (HP/CL), the low potential cereal/livestock (LP/CL) and the high potential perennial crop/livestock (HP/PL) area (Amaze G. 1978), which has distinct livestock production system. In contrast, the lowland has 78 million hectares land area (60% of total) and 12.2% of the total human population. Ecologically it has arid (64%), semi-arid (21%) and sub-humid (15%) area dominated by semi nomadic transhumance population whose economy is entirely dependent on livestock production (Solomon D, 2000). Seasonal migration and the tendency of overstocking in specific area are the major characteristics.

Estimates made by the Ministry of Agriculture (MOA, 1999) indicate that Ethiopia has one of the largest livestock populations in Africa with 87.1 million grazing livestock equivalent to 35.0 million

TLU. Accordingly there are about 34.6 million cattle, 24.9 million sheep, 18.7 million goats, 1.16 million camels and 8 million equine. The respective annual population growth is estimated at 1.3%, 1.0%, 0.9%, 1.1%, and 0.8% (Getachew Felleke and Gashaw G., 2001). The Ethiopian cattle population accounts for 19.1% of Sub Saharan Africa (ILRI, 2000).

Livestock are an important source of food, particularity of high quality protein, minerals and vitamins. As a source of income, it is most important cash generating activity for purchase of food, agricultural inputs and other family needs. In the generation of employment, increased production implies higher employment in the production and processing and marketing sector. Livestock as supplier of inputs and services for crop production is worth mentioning where draught power, manure, fuel, weed control and recycling of own secondary products.

Cattle, camels and goats are the main livestock species in Ethiopia that supply both milk and dairy products. Milk from cows constitutes 83.4 % of the total annual milk output of the country (FAO, 1993). Estimated total milk production ranged from 960, 000 metric Tons for 1994 to 1,197,650 metric Tons for 2000 showing meagre growth (Getachew and Gashaw, 2001). This low production is reflected in the very low per capita consumption of animal protein. The average per capita consumption of milk in Ethiopia, Africa, developing world and the world was 19.2kg, 27.5kg, 36.6kg and 75kg respectively (FAO, 1992), which shows the per capita consumption of milk in Ethiopia is 52.5% of developing countries and represents only 15-30% of that of the developed countries (Azage and Alemu, 1997) and has also decreased substantially during the last 25 years by 23.8% (Berhanu, 1998). Productivity is low due to genetic and environmental factors reflected in low daily yield (1.17kg), short lactation (195 days) length and extended post partum period (CSA, 1995; Alemu et al 2001; Mukassa-Mugerewa, 1989). The reduction of milk consumption levels and the fact that the country is importing milk products while possessing a large livestock population is a very good indicator of the complexity of the problem.

Milk is produced in widely scattered rural areas and mainly consumed at home or sold in the area produced. A substantial amount of the milk is processed into butter, which reduces the amount of milk that should be available for liquid milk consumption. Almost all milk supply to major towns is from urban and periurban areas, with the exception of Addis Abeba where milk is supplied from rural areas as well through the formal market. At present the formal milk market has two main sources, Shola Dairy of the Dairy Development Enterprise and Mama Dairy of Sebeta Agro Industry dairy. The large demand-supply variance in milk that exists in the country, with a possible increase in the purchasing power of the population indicates that there is potential and opportunity in milk and dairy products marketing in supplying a wide variety of products both in quality and quantity provided the formal market can expand to secure a steady milk outlet for producers.

Losses attributed to post harvest problems from production to consumption through collection, processing and marketing are immense both on the formal and informal milk and dairy product marketing structure. These wastages may be of potential losses (wastage of milk incurred due to mishandling and spoilage and uneconomical use of locally produced milk) or efficiency losses (attributed to use of low level of technology to preserve and convert milk to other dairy products). In a country where milk is produced mainly from smallholder farmers, the produced milk both at household and animal basis are small, infrastructure and legislation for proper care of the milk to improve its quality and safeguard the population from health hazard is not developed, measures to decrease post harvest losses is a challenge that needs proper investigation. In reducing post harvest losses and to boost production, the provision of a steady outlet for the milk produced is vital. Hence, introduction of proper production, collection, transportation, processing, packaging and distribution should be in place to improve quality. This will induce reduction of wastage and helps in product diversification to make milk and dairy products available at affordable prices and acceptable by a range of consumers. In addition traditional methods of milk handling and processing technologies need be thoroughly studied to identify major constraints and provide a better understanding of the system to introduce appropriate innovations for effective utilization.

The aim of this paper is to assess the milk production and marketing system of the country in terms of its potential, identification of constraints and identify opportunities for future development in enhancing productivity with special reference to smallholder dairy development. The potential role of small scale dairy farming and the associated organizations in contributing to the development of the sub-sector from production to consumption through processing and marketing will be reviewed with the objective to improve the welfare of the resource poor livestock owners and low-income consumers through increased supply and marketing of safe, better quality milk and dairy products. Identification of use of appropriate technology and dissemination processes in reducing post harvest losses and improving quality in enhancing milk production and availing more, safe and healthy milk will be addressed as part of the FAO Action Programme for the prevention of food losses of the Country Assessment report for Milk and Dairy Products, Post Harvest Losses and Food Safety in Sub-Saharan and the Near East.

II. BACKGROUND

Dairy development in Ethiopia had past through three stages (based on the socio-political situation of the country prevailed in the periods identified), which affected its sustainable growth. These are the pre-rural land reform period up to 1974, the socialist period of 1974-1992, and the mixed economy, and liberalization and structural adjustment period after 1992. Past efforts and the impact of political changes resulted in categorizing dairy development in Ethiopia as commercial and smallholder or dairy development using exotic, improved and indigenous breeds of cattle.

A. HISTORY OF GOVERNMENT AND PRIVATE SECTOR INVOLVEMENT IN DAIRY DEVELOPMENT

Based on the level of technology used and for ease of differentiating progress in the supply system efforts made in the development of dairying in Ethiopia with involvement of government and private initiatives can described in two categories, as commercial and smallholder.

1. The Commercial Dairy Development

The United Nations Relief and Rehabilitation Administration (UNRRA) under the post Second World War Relief Programme in 1947 donated 300 Friesian and Brown Swiss dairy cattle, which were used as a nucleus herd for Holeta and ex- Shola dairy farms. This is considered as the first attempt to introduce modern dairy production in the country. There is also information that indicates missionaries and some foreigners had introduced European dairy breeds earlier. Dairy breeds introduced by individuals and different institutions include the Jersey, Guernsey, Ayrshire and Simmental (Abaye Tedla, et. al., 1989).

The establishment of milk processing by UNICEF with a small milk boiler and a manual packing facility in Addis Abeba in the same year with the aim to provide milk processing technology to supply an increased quantity of clean hygienic milk for the urban population and additional protein source for the vulnerable group of the population was also an important milestone in the development of the dairy industry. The Shola milk plant was set in 1967 with a pasteurization capacity of 10 tonnes per day and the establishment of 54 milk purchasing and collection centers to serve as sources of raw milk for the new plant within a 10km radius of Addis Abeba. Subsequently, the milk processing capacity was expanded up to 30 ton per day and raw milk collection was strengthened and expanded in areas up to a 70km radius and then up to a 120 km radius in 1969.

The organization of Addis Abeba Dairy Industry with responsibility to control and organize the collection, processing and distribution of local production in the milk-shed areas of the city and growth and increased interest of farmers in dairying necessitated the establishment of an independent body with dairy development mandate in the country. The Dairy Development Agency (DDA) was established as an autonomous public authority of the Imperial Ethiopian Government under Order Number 72 and Proclamation number 283 of 1971. The Agency's duties and power included the establishment and running of dairy farms and milk processing plants; training of dairy farmers and technicians; importation, raise and sell of dairy stock; provision of veterinary, breeding and advisory services; encouragement and support research on dairying (Negarit Gazeta, 1971). DDA was then responsible for the feed processing plants, supply of farmers with concentrate feeds, to encourage organization of dairy cooperative societies, to encourage dairy farmers with guaranteed sale of milk at prices fairly related to the consumer price and support the provision of dairy development loans, technical and advisory back up services.

The First Livestock Development Project (F_1LDP), known specifically as the Addis Abeba Dairy Development Project started in 1972 with a loan from the World Bank. It was designed to set up individual dairy farms including 240 small dairy farms (10 milking cows each) and 110 medium size dairy farms (40 milking cow each) in potential dairy Weredas around Addis Abeba by financing through AIDB. Six crossbreeding ranches were to be established to produce crossbred dairy heifers and DDE's capacity expanded by improving the milk collection, processing and distribution centers (Getachew Felleke and Gashaw G., 2001). Implementation was limited with establishment of 30 medium and eight small-scale dairy farms with distribution of 964 grade and crossbred in-calf heifers (MOA, 1991). Improvement of the processing capacity and establishment of 13 and renovation of the 8 milk collection centers within a 120 km radius of Addis Abeba were also the achievements of F_1LDP. The project was operational until the major political change of 1974 and DDA was handed over to the Ministry of State Farms Development (MSFD) in 1978. The DDA was reorganized in 1978 to Dairy Development Enterprise (DDE) to work under the Ethiopian Livestock and Meat Corporation of the MSFD with activities limited to running the state dairy farms and the Addis Abeba milk processing plant.

With the assistance of the Government of Finland and the United Nations Capital Development Fund (UNCDF) under "Assistance for Dairy Development (Eth/82/C01)", the processing plant was equipped with additional equipment, butter oil recombination introduced, 30 collection kiosks and 16 chilling centers established, and the milk collection routes extended to a radius of 150 km.

In 1982 World Food Programme (WFP) provided 2,930 tons of dried skim milk, 880 tons of butter oil and 325 tons of dried whole milk worth 4,648,000 USD (to be used for recombination of 29.3 million liters milk equivalent) to utilize the potential capacity of the Addis Abeba milk processing plant by increasing production with an additional 16,000 liters per day (Getachew F. and Gashaw G., 2001; MOA, 1985). The proceeds from the use the donation were targeted for funding dairy development and the Small-scale milk processing Project (FAO/WFP), teaching and research institutions. The artificial insemination service also have benefited from this fund.

Dairy Development Enterprise was also assisted by the DRDP, the aim of which was to rehabilitate and expand the dairy farms by consolidation and expansion according to the recommendation of the national livestock sub-sector review of 1984. To this effect four dairy farms (Kumbi, Addis Abeba, Kaliti I and Kaliti II) were closed and improvement of the capacity of the remaining eleven dairy farms was implemented through provision of machinery, improved forage production, herd restructuring, improved management and training and support services (DRDP, 1994).

In the private sector there are many dairy farms (their number and size are not currently known) with exotic and grade dairy cattle in the major urban areas and peri-urban highland regions of the country.

Only a few farms have pure dairy stock and are concentrated in government institutions and a few individual dairy farms mostly known as town cow dairy farms (since most of the dairy farms are located either in the urban areas and suburban areas especially after the rural land proclamation of 1974). The majority of dairy farms use grade and nearly pure Friesian, Holstein-Friesian and Jersey breeds are also used, the source of which are from surplus stock from state, research and teaching institutions and intensive private dairy farms. During the mixed economy announcement of 1991 dairy farms established with distribution of F_1 in-calf heifers under service and producer cooperatives were dissolved and the improved dairy cattle on these farms were sold to urban and peri-urban farmers.

The privatization of the state dairy farms resulted in a number of farms being run by individuals or commercial entrepreneurs. Of the 14 farms run by DDE twelve farms were either retuned to their previous owners or sold out. These farms have now expanded their activities to including -processing of milk to other products and diversified farming activities such as horticulture etc, (field assessment).

2. Smallholder Dairy Development

Early interventions of Government services in livestock development were geared towards animal health activities with the establishment of the Veterinary Services Directorate, the activities of which were focused on running vaccination campaigns and development of directives in animal health. However, with dairy development activities proliferating around the main towns and the need to enhance production led to the Ministry involvement in developing programmes and planning in livestock development.

Livestock development activities began late in 1960 as an integral part of the agricultural extension services with introduction of exotic dairy breeds in the highland areas near major urban centers.. F_1LDP (ET269) was the first major effort in this field with emphasis on introduction of improved dairy breeds and involvement of small-scale dairy farmers in the peri-urban and rural areas of Addis Abeba. This was followed by Swedish International Development Agency (SIDA) supported Chilalo Agricultural Development Unit (CADU), initiated in 1967, and the Wolaita Agricultural Development Unit (WADU).

CADU and WADU had shown some promising results. Nevertheless, due to high costs and the high level of skilled manpower per beneficiary it was impossible to expand and implement these activities in other areas. The Minimum Package Programme (MPP), which was regarded as a less expensive approach of reaching a larger segment of the peasant population in Ethiopia, was established in 1971and the Extension and Project Implementation Department (EPID) of the MoA was mandated to offer farmers an integrated minimum agricultural services and inputs package. The Livestock Extension service was included in the second phase of the project (MPP II) and was operated by the then Animal Resources Development Department (ARDD) of MoA. These development programmes indeed contributed substantially to the introduction and development of dairy extension in Ethiopia. Projects geared to comprehensive dairy development programmes in Ethiopia were then carried out with the implementation of Dairy Rehabilitation and Development Project (DRDP) followed by the FINNIDA assisted projects of the Selale Peasant Dairy Development Pilot Project (SPDDPP), Support to the National Artificial Insemination Center (NAIC) and the Smallholder Dairy Development Project (SDDP). Small scale Milk Processing Project of FAO/WFP, FARM Africa (goat milk development and camel projects) and the World Food Programme Assistance to dairy development Project (ET/2500) were also projects that were implemented in selected dairy potential areas. Other projects, which catered indirectly to dairying, included the Fourth Livestock Development Project (F_4LDP), the Pan African Rinderpest Campaign Project (PARC) etc.

Projects targeted for lowland livestock systems included the Southern Range lands Development Pilot Project (SORADEP), Second Livestock Development Project (SLDP), Third Livestock Development

Project (TLDP) and South-eastern Rangelands Project (SERP). SORADEP was the first to be implemented in 1965, funded by USAID in Yavelo area. It was aimed mainly on assessment of the potential and use by introduction of management practices and improving water supply of the rangelands. SLDP was implemented in 1973 to develop integrated livestock marketing with an emphasis on pastoral areas, TLDP was the first large-scale range improvement attempt in Ethiopia, which was implemented in the three main lowland areas of Ethiopia namely the Southern rangelands, Jijiga rangelands and Northeast rangelands as sub projects for Borana, Ogaden and Afar areas respectively. More recent development interventions had included the pilot project at Southern Rangelands Development Unit (SORDU) in conjunction with the FLDP (1988), and SERP in the Ogaden (initiated in 1990). These projects were generally intended to foster greater integration among lowland and highland production systems.

Currently three projects, National Livestock Development Project (NLDP), Pan-African Programme for the Control of Epizootics (PACE) and Farming in Tsetse Infested areas (FITCA) are currently operational on livestock at national level. The NLDP, which is an outcome of the National Livestock Development Programme of 1997, is now being implemented throughout the country, in both highland and lowland areas. This project with a soft loan from the African Development Fund, it has three main components namely Animal health improvement, Strengthening of the Artificial insemination services to develop the cattle improvement programme and Forage development.

B. DAIRY DEVELOPMENT IN THE LAST 30 YEARS

1. The state dairy farms

Dairy farms under Government control prior to 1975 included the Holeta Dairy and Shola Dairy, which were run by the MOA and DDA. Changes in the political system of the country and the rural land proclamation was then the base for establishment of the state dairy farms with the nationalization of most of the large dairy farms including dairy farms established by the First Livestock Development Project where twenty-three private dairy farms were nationalized and consolidated into 19 state dairy farms with a foundation stock of 1,734 dairy cattle. A major herd introduction was made when the Cuban Government donated 120 Holstein-Friesian heifer/cows in 1980 and 500 Jersey cows were purchased by DDE for Adaberga dairy farm.

The performances of dairy herds in the state dairy farms were not satisfactory in terms of efficiency and total milk produced. Daily milk production, herd average/cow/day and lactation yield parameters indicate a low level that was not be expected from such high yielding breeds. The lactation yield ranged from 2,028 to 5,161kg with average of 3,124 kg of milk, (305-day yield of 1,037 to 4,266kg) with a lactation period of 340 days (Getachew et al 2001).

The total herd size of the state dairy farm was reported to show less than expected population growth. Herd size was 3,855 for 1982/83; as of April 1985 the population had increased to 4,880 and had then decreased to only 2,325 in 1991/92. Cattle on milk for 1982/83 and 1991/92 indicated only 36.3% and 34.0% followed by 28.7% and 32.4% for non-pregnant heifers respectively. There was a high decreasing trend in cattle size from 1991/92, which is partly due to sales of some farms under the privatization policy of the country.

2. The private dairy farms

The study carried out by Ministry of Agriculture in 1978 to assess the situation on dairy farms after the rural land proclamation of 1975 indicated that there were 158 dairy farms with 3,381 grade cattle within radius of 150km around Addis Abeba MOA, 1979). At the time of study it was found that 53% of the

farms used to be run by private holdings were maintained by their respective holders, 10% were under government control, 6% were controlled under Peasant Associations and 31% farms were abandoned.

After 20 years, a census carried out by the Addis Abeba Region Bureau of Agriculture (1998) reported the presence 27,249 improved and exotic dairy cattle in the region. The total population of milking cows was 58, 566, which included the 31,319 indigenous milking cattle mainly found in the rural Weredas (Table 2). The City Administration had registered 5,167 private dairy holdings with exotic blood. The dairy farms used mixed breeds of crosses and grade cattle with few pure exotic dairy breeds. The distribution of these farms indicated that 4,825 farms (93.4%) had up to 5 exotic cows per holding, 200 farms (3.1%) were with 5-10 exotic cows, and 142 farms (2.7%) with more than 10 exotic cows. This scenario indicates that recent features of dairy development in smallholder dairy farms using cross and grade cattle are expanding. However, the increase is in the number of farms with smaller sizes but there is no trend in increasing in herd size.

Table 2: Size of livestock population in Addis Abeba administrative Region, 1996

	Exotic	Indigenous	Total
Cows	14,045	9,177	23,222
Heifers	4,720	3,840	8,560
Female calves	4,404	3,815	8,219
Male calves	2,316	3,044	5,360
Bulls	588	671	1,259
Total cattle including oxen	27,249	31,319	58,566

Source: Getachew Felleke and Gashaw G., 2001

3. Milk processing and marketing

Currently the potential capacity of the Shola milk processing plant (60 ton/day) is not fully utilized. Data from ten years performance (1991 to 2000) indicate an annual processing average of 4,703.8 Ton (Getachew Felleke and Gashaw G., 2001). Maximum utilization of the processing capacity of the plant was reported in 1981/82 with 52.8% while the lowest was in 1992/93 with 9.9% utilization. Over the periods 1981/82 to 1995/96 average intake was 33.5% (Belachew, 1997). From the processed amount 89.9% was used for sale as pasteurized milk annually. The rest 11% of the milk is used in the production dairy products such as butter, Ayib, cheese and yogurt the average amount of annual production of which were 67.5 tons, 44.3 tons, 7.9 tons and 23 tons respectively (Annexes 2 and 3). Sources of milk for processing were 44.1% from own production, 44.7% from farms other than its own and the rest 11.2% from powdered milk utilization. Powdered milk utilization was for years 1991 to 1997, the highest utilization being from 1991 and 1992 (Getachew Felleke and Gashaw G., 2001).

Other than DDE a number of small-scale and a few medium and large scale private dairies are operating around Addis Abeba and other urban areas. These small-scale processing enterprises use their own milk from the peri-urban farms for processing. The major commercial processor are Sebeta Agro-industry in Addis Abeba milk shed area and Dire dairy Ltd. in Dire Dawa. Sebeta Agro-industry with a brand name of 'Mama' milk is pasteurizing milk and manufacturing dairy products from its farm and collects milk in Sebeta, Sululta-Fiche and Debrezeit milk shed areas. The capacity of the dairy is 30 ton per day and it is reported that current processing throughput is on average 8 tons per day (personal communication). It has milk-chilling centers in three sites along its collection routes and within Addis Abeba. Dire dairy Ltd. known as 'Hamdael' is operational in Dire Dawa Region with a homogenizing plant for whole milk and uses milk from its own farm only. Dinsho Agro-industry, through its affiliated Din System PLC, had temporarily started a milk processing activity in Sebeta area, which was not widely commercialized. To date Dinsho dairy plant is not functional.

4. Smallholder dairy

CADU and ARDU had pioneered the one cow unit dairy development package, began in-country production of crossbred heifers, contributed to the popularization of cultivated forage production, began in-country frozen cattle semen production, introduced AI to smallholders, introduced small scale milk processing units and served as a model in the development of other comprehensive projects. WADU on the other hand served dairy development in rendering AI and bull stations for breeding services and established a dairy farm of 290 herd of Holstein-Friesian. EPID had taken the CADU and ARDU approach in introducing crossbred dairy package in other parts of the country more widely.

The Animal Resources Development Department had broadened the scale and scope of dairy extension service in Ethiopia initially by conducting the Livestock Subsection Review in 1984 and establishing new cattle breeding and multiplication ranches at different locations in the country.

The Dairy Rehabilitation and Development Project (CS\ET\AGR\85\17), the outcome of the Livestock Subsection Review in 1984, was a comprehensive dairy development project covering most dairy potential highlands encompassing both the state and smallholders. Implemented jointly by the Ministry of Agriculture, Ministry of State Farms and the Agricultural and Industrial Development Bank (AIDB). Project components included smallholder dairy farm development, rehabilitation and improving of the operational efficiency of the state dairy farms, production of crossbred in-calf heifers by expansion and development of two cattle multiplication ranches and running contract crossbreeding, veterinary services, butter marketing, trials and studies and training. Smallholder dairy farm development included the establishment of dairy farms by distribution of crossbred in-calf heifers under cooperatives and private smallholders in the stratified major milk producing areas. The provision of input and services through a specialized dairy extension system include heifer distribution, forage development, and herd registration and recording scheme. During its implementation period from 1986 to 1992 it had established 48 cooperative dairy farms of ten cows and one bull model and 615 smallholder one-cow one-man smallholder dairy farms. Subsequently a total of 1,607 heifers including 1,125 crossbred heifers for the project farms and 582 crossbred heifers for non-project areas were distributed. Distribution to non-project area includes service cooperatives, institutions and individuals in urban and per-urban areas.

In the same socialist period when DRDP was operating, Selale Peasant Dairy Development Pilot Project was implemented between 1987 and 1991 in the former Selale Awraja. The aim of the project was to assess the applicability of increased sustainable smallholder production in the highland of Ethiopia through the introduction of crossbred dairy stock and improvement of cooperative services. This technology was introduced under individual operated smallholder dairy farming approach. Components of the project include introduction crossbred dairy stock and fodder production technology; strengthening of cooperative infrastructures for input provision and development of primary and secondary level market for dairy products and monitoring and evaluation. It had distributed 300 crossbred dairy cattle for equivalent number of peasants (SPDDPP, 1992).

The Small scale Milk Processing project (FAO/WFP) was implemented in two sites (Lemu Arya in Arsi and Sike in the former Southern Shewa Province) between the years 1991-1994. FAO provided technical assistance and milk processing equipment and WFP provided the financing of the dairy structures. Lemu Arya dairy cooperative milk processing unit was functional soon after the completion of the dairy structures. It had registered promising results in organizing and smooth operation of a dairy cooperative, in serving as milk out let function and providing adequate milk to the nearby urban areas and is progressing well (Getachew F., 2001).

Based on the evaluation of Selale Peasant Dairy Development Pilot Project the SDDP was implemented to replicate the introduction of crossbred dairy technology into wider area of similar agro-ecology and socioeconomic condition in the regions of Amhara, Oromiya and SENNP. The project, which ran from

1993 to 1998, had distributed 455 in-calf heifers and introduced 53 bulls; established 34 milk processing units and constructed 11 hand-dug wells, 9 springs and 3 ponds. Farmers were trained on basic technologies in fodder production, milk processing, artisan and breeding. Technicians were also trained and participated in organized study tours to promote technology transfer.

NLDP started its activity in 1999 with part and all of the components of the project covering all regions of the country. It has three main components namely livestock production, animal health and forage production all of which had part in the development of dairying. Main activities of the livestock production component include strengthening of the capacity of NAIC, establishment of seven regional AI sub-centers, establishment of bull-dam farm, training of artificial insemination professionals and technicians. The forage development component follow the strategy of F_4LDP with activities in forage seed production, introduction of appropriate fodder production, seed quality control and training of professional and farmers involved in fodder and forage seed production. The health component is basically capacity building in which veterinary clinics and laboratories will be strengthened.

Projects geared to small ruminants and camel do not have wide coverage and recognition by the Government is minimal and can be considered as non-existing except the two projects run by FARM-Africa, a non-government organization involved in rural development. A Goat Development Project was started in 1988 mainly on the southeast and Eastern Highlands where population pressure is high with aim to serve the poorest of the poor, especially women by providing improved goats on credit and training on improved goat management. The second phase of the project, which was started in 1998, covered four regions and about 2,000 households in 16 Weredas. The Afar pastoralist's project started its activity in the northeast rangelands in 1998 designed to provide basic training in camel health and camel management.

5. Dairy Research

Research focus in improving milk production, in the past, was based on the highland cattle production system and improving breed characters. Different institutions were involved in crossbreeding studies including Alemaya College of Agriculture (now Alemaya University), IAR and CADU/ARDU. A study carried out by Alemaya University, though of short duration, had shown the production potential of pure Friesian and their crosses through improved feeding and management as an important indication for intensive dairy production on the highlands. The IAR study was aimed at providing guidelines for dairy breeding policies for different agro-ecological regions. To these effect three indigenous cattle breeds, namely Boran, Horo and Barka were crossed with Friesian, Jersey and Simmental and comparisons were made for cool high land, sub-humid, semi-arid and arid agro-ecological regions with effect of sire and dam breed and genotype and environment interaction assessed for contemporary comparison of local, F_1, F_2 and ¾ exotic genotypes. The result showed that crosses of 50% to 65% exotic blood are appropriate for smallholder dairy production.

Research conducted by CADU/ARDU showed the same trend in performance for the different levels of exotic gene (Brannang E. & S. Persson, 1990). In general there is a clear superiority of all crossbred over the indigenous breeds. There is similarity of 75% and 50% exotics where milk yields were only 13% higher in 75% while the overall productivity was the same with 50%. There is also lack of superiority of the Friesians over the Jersey crosses. Jersey crosses were 12% inferior to Friesians in total milk and 14% superior in overall productivity (Kiwuwa et al, 19985). The rankings of breed groups on smallholder farms were identical to their rankings on station, although the sizes of the differences varied (Getachew F, & Tesfaye C., 1999).

Minimum efforts have been made to evaluate the indigenous cattle and others for milk production. The IAR on-station research result on milk yield of local cattle indicated that Borana, Horo and Barka produced 494, 675 and 559 Kg per lactation respectively. Arsi and Fogera breeds also show similar

trends producing 872 kg of milk (EARO, 1999). Some of the research outputs are indicated in the following table.

Table 3: on-station performance of indigenous, exotic and local crosses in the Ethiopian highlands

Category	Birth weight (kg)	Age at first calving (days)	Lactation		Caving interval (days)
			Milk yield (kg)	Days in milk (days)	
Boran	24.5(1987)	42.6(932)	682(76)	120(76)	443(4151)
Horo	18.3(198)	53(58)	560(96)	132(58)	494(79)
Arsi	21.5(64)	34(62)	224(233)	272(233)	439(202)
Fogera		46(51)	674(51)	150(51)	500(51)
Barka (Begait)	22.1(134)	60(27)	637(128)	194(27)	458(48)
Mean Zebu	23	43	618	150	444
Mean Friesian		40	3560	350	451
Friesian cross F_1		33.4	2165	341	429
Jersey F_1		32.4	1737	326	412
Brown Swiss F_1		35.3	1921	337	435

Source: Compiled from Alemu et al, 1998, ARDU, 1978 and ISCDD (IDF), 1981

6. Breeding and Artificial Insemination

The implementation of artificial insemination services dates back in 1950 and in 1960 when teaching institutions and DDA started the service using fresh and imported semen. The service was expanded with establishment of the Asela Artificial Insemination center in 1972 by CADU. The National Artificial Insemination Center was then established in 1981 with the mandate to serve at country level. Initially, service was based on production and use of fresh semen until the liquid nitrogen plant installed in 1984. Bulls donated by Cuban Government (25 Holstein and 10 Brahman) and importation of 44,800 doses of Friesian and 2,000 doses of Jersey semen were source of semen used for frozen semen technology (Getachew Felleke and Gashaw G., 2001). The center operates well-equipped semen processing laboratory and liquid nitrogen processing plants. To date semen collection was based on exotic and indigenous as well as crosses of these breeds namely Friesian, Jersey, Brahman, Boran, Barka, Fogera, Horo, Sheko and crosses of 50% and 75% Holstein-Friesian and indigenous bulls. From the total semen produced the major share is from Friesian (75.3%) followed by Jersey (10.5%).

Asela dairy farm was used as rearing and training center of bulls with the provision of semen collection and small quality control laboratory. Kaliti is serving as the main semen collection and preservation center, the satellite AI centers to be used for services and the recently acquired Holeta bull dam farm will be the base for nucleus bull producing, testing and rearing farm.

7. Distribution of improved dairy heifers

A total of 9,143 in-calf crossbred heifers have been distributed from Government ranches to individual farmers, service cooperatives and producer's cooperatives up to 1998 (Getachew Felleke and Gashaw G., 2001). Of the total number of crossbred heifers distributed CADU and ARDU contribution 21%, while the MoA, irrespective of the Department and Project, distributed 79%. The highest record of crossbred heifers distributed (749) was achieved in 1979/80, some ten years after the first crossbred heifers distributed by CADU. Lower rate of in calf heifer distributions per year since 1979/80 was due to the absence of registered PCs during the cooperative dairy development period of DRDP. With the

dissolution of producer cooperatives most of the distributed animals and/or their progenies are likely to be owned/managed by individuals residing in peri-urban and rural areas of the country.

It is estimated that a total of at least 39,400 graded dairy animals are managed by the peasant sector (Getachew Felleke and Gashaw G, 2001). The estimates indicated that 67% of the graded animals could have been produced from the crossbred heifer distribution scheme, while 33% of the additional graded dairy animals are outputs from the artificial insemination scheme of the local cattle.

C. C. LESSONS LEARNT FROM PAST AND ONGOING INTERVENTIONS IN THE DAIRY SUB-SECTOR

1. Commercial Dairy Development

i. Introduction of exotic dairy breeds

The introduction of different exotic dairy breeds (Friesian, Jersey, Holstein, Brown Swiss, Guernsey, Ayrshire, and Simmental etc.) in the highlands of Ethiopia had proved that these dairy breeds and their crosses are adaptable to the Ethiopian highland provided that the management level is adequate. The potential performance of these breeds has been evaluated by research (Holeta and Debrezeit research stations), teaching Institutions (Alemaya and Ambo), CADU/ARDU (Asela dairy farm) and their performance on private and state dairy farms since 1947. The best exotic dairy breeds with wide acceptance as recommended, based on the research and production performance, by the draft breeding policy of Ethiopia are the Friesian and Jersey (Getachew Felleke and Gashaw G., 2001). These are the exotic dairy breeds that are widely present in the country with the state, urban and peri-urban private dairy farms as pure and grade and smallholder farms as crossbreds.

ii.Commercial dairy farming

Establishment of large scale dairy farming using exotic breeds is possible in peri-urban highland where market outlet is not a constraint and access to collection, transportation and processing of milk is adequate. Provided the management skills of the producers in terms of feeding, breeding, health and husbandry practices are high introduction of pure and grade dairy cattle are practical.

iii. Milk collection and processing

The establishment of milk collection, chilling and processing infrastructures had positive impact in encouraging production in the rural areas not only of the private dairy farms but also from smallholders who use both improved and indigenous stock for milk production. Use of market oriented dairy development approach calls for this system to flourish to gain steady milk out let. This has an additional advantage in providing safe and quality milk to the consumers.

The present milk processing plants are working below capacity. It was reported, for instance that, DDE had managed to use on average 35.2% of its performance (Belachew, 1998). Reasons for low efficiency might vary from resource to management level; however, this had hampered efficient and steady collection of milk from the peri-urban and rural commercial and smallholder producers. Both the consumer, due to limited products availability and the producer with less efficient and unstable market are not benefiting from this sector. This led to low performance of the sector where the producer and consumer are less enthusiastic to use the formal marketing system. Investment and

involvement in milk collection, transportation, processing and distribution by both the Government and private sector should be regarded as vital if progress in this sector is expected.

2. Smallholder Dairy Development

i. Introduction of Appropriate technology

Based on the research finding (IAR, CADU and literature) the pioneering activity was the identification and demonstration of the technology using high yielding and adaptable cattle in the highlands. Both the comprehensive (CADU, WADU) and the minimum package program (EPID) had introduced crossbred heifer and demonstrated this technology to increase milk production in their respective project areas. They followed an extension package approach using model farmers, sale of heifers to model farmers on a credit basis with subsidized prices and encouragement of peasant associations to have their own cross breeding mini-ranches to produce F_1 cross heifers. Crossbred in-calf heifers for distribution to individual farmers approach was later modified to distribution of heifers to service and producer cooperatives to establish dairy farms under the socialist mode of production.

The comprehensive package development programmes have shown some promising results but the high costs and the level of skilled manpower required per beneficiary did not warrant continuation. As an alternative the Minimum Package Programme was found appropriate due to its integrated minimum agricultural services and inputs and less expensive approach of reaching a larger segment of the peasant population in Ethiopia.

The shift in emphasis from establishment of cooperative dairy farms to smallholder farmers in the DRDP and the positive evaluation of the SPDDPP, where introduction of crossbred into the mixed farming system and the expansion of involvement of service cooperatives in integrating input-output of the farming system are applicable had brought the opportunity for greater expansion of small scale dairy development activity.

The early phase of dairy development promotion was basically based on, provision of breeding services with establishment of bull services both at service cooperatives and Government level and provision of artificial insemination services. Later heifer distribution to establish smallholder dairy farms encouraged participation by more farmers. As a demonstration heifers had to be distributed in different places the scattered distribution of improved heifers did not warrant expansion of the system due to problems in rendering services in breeding, health and extension. The limited breeding services had led the use of uncontrolled mating resulting in loss of progress in genetic improvement expected. Services geared to health and forage development and extension activities were not complete due to widespread distribution and limited manpower to cover the areas intended. The use of Milk shed Area as a market outlet and Dairy Colony for basing distribution of heifers in a locality was initiated in the last phase of DRDP.

Different approaches to crossbred heifer production were developed by ARDU and DRDP. These efforts were incomplete, the effect of which was that the increase in the number of heifers produced could not be sustained and guaranteed. ARDU had engaged peasant associations to produce F_1 crossbred to enhance the supply of improved dairy cattle. Assistance given to the societies was on coverage of costs of semen and services of AI technicians as well as advice on technical matters relating to animal production. Farmers involved were only paid for herding, guarding and for obtaining and AI certificate. It was reported that approximately 5,000 crossbred heifers were produced by this group-breeding scheme. A Contract crossbreeding programme was carried out by DRDP in five sites in two administrative regions. A total of 535 local heifers were bred with Friesian semen and 296 calves were born of which 156 were female. Only 7 heifers were collected by the project, the rest being kept by the participating farmers and some sold to farmers in peri-urban and urban areas with higher sales

value than the project was paying under the agreement (Getachew Felleke and Gashaw G, 2001). The DRDP had also established a Jersey bull multiplication center at Wolaita to distribute bulls in areas where there is high population density and scarce feed resource and raw milk marketing was not developed.

The use of specialized dairy extension services by DRDP was encouraging in respect to the emphasis that had been given on promotion of the technology. The project had a strong dairy extension system, from national level headed by the Chief Dairy Officer, Senior Dairy Officers at Regional Level and Dairy Officers at Wereda level. This had been the accepted structure and staffs were assigned accordingly with the mandate and responsibility of running dairy development activity in their respective domain. The Project had trained 18 staff of both the Ministry of Agriculture and Dairy Development Enterprise on extension, forage production, dairy management and veterinary fields at MSc level, had provided short courses for dairy officers and organized a study tour for senior staff in dairy and dairy related development activities. The specialized dairy extension had to be discontinued due to reorganization of the MoA and restructuring of Regional Agricultural Offices following phasing out of the project.

The importance of having a good monitoring and evaluation component in a development programme is vital in assessing the implementation status and evaluation of the application of strategy for sustainable development projects. In most of the development projects this was not practiced as a component or was not properly used for complete and comprehensive evaluation of the projects to come up with concrete recommendations. Selale Dairy Development Pilot Project had a strong project monitoring and evaluation component in which all of the project activities have been valued, case studies carried out and research on specific problems have been under taken to come up with recommendations for suitable interventions required in dairy development. The lessons learnt from this project helped in replicating the integration of dairying into the smallholder farming system to other areas of the country with similar agro ecological and socio-economic conditions. The output of this project is the Smallholder Dairy Development Project where three Regions with similar agro-ecological and socio economic conditions were involved in the implimentation of more comprehensive dairy development activity.

ii. Dairy herd register and milk Recording

Implementing a dairy herd improvement programme through the application of Herd Register and Milk Recording were components in DRDP and SDDP. Attempts to review dairy recording in the different institutions involved in dairy research, teaching and milk production were made by DRDP to come up with a proper recording system. The recommendation was to use a national recording system applicable to all institutions by developing a software package that can also be flexible to accommodate data for specific needs of the institutions involved. It had been tested under the smallholder dairy production system and was run for a limited period. The Application of Daisy was also tested. Due to its large herd size and use of more parameters use application, Daisy was recommended to DDE dairy farms but not used. Based on DRDP activities the National Artificial Insemination Center revised the recording system for use in selection of bulls for semen collection. The last attempt to have a Dairy herd register and milk Recording system was made by SDDP which developed a long term document on recording system and Access based software for data entry and output. A pilot recording system was introduced to selected farmers in the project area involving 150 farmers from the three regions. However, the pilot phase was not completed as planned and committed in the programme developed by the project. It had to be terminated because of the completion of the project.

iii. Introduction of small scale milk marketing

In finding a milk market outlet almost all projects and programmes had activities of milk collection, processing and marketing. ARDU had established a milk marketing system to collect milk from the

project area and process for urban consumers, which is not now functional. DRDP had a small scale milk processing and butter marketing component. It distributed 20 sets of milk processing units to cooperative dairy farms. DDE is still operational in all five routes with reduced capacity. Mama has started to collect milk from the same route and on contractual terms from producers and marketing groups. All the above were supposed to cater for collecting milk from smallholder farms but are either non/functional to date or inefficient.

In the small scale milk marketing a pioneering activity was led by farmers in Bilalo in Arsi and Bakelo in North Shewa with the establishment of marketing units. Bilalo farmers initially grouped themselves to collect milk from their village, transport and sell it to a user in Asela on a contract basis. To date they have organized themselves into milk producer user-groups collecting, processing and marketing milk and dairy products directly to consumers. Bakelo farmers transformed their service cooperative into milk processing user-group by getting access to cream separator and butter churn from DRDP and initially assisted by ILCA. DRDP had introduced a cream separator and butter churn technology to implement its marketing component. Forty sets of milk processing units had been procured by the project for this purpose where this equipment were sources of input for part of the processing established by MOA, Regional Agricultural Bureau and the SDDP small scale milk processing units. The major activity carried out in small scale milk marketing is by SDDP where it has assisted in establishment of 34 small scale processing units in project areas where milk is processed and a number of retail outlets have been set up. Products include raw and skim milk, ergo, Ayib and butter. Their marketing strategy has been to firstly to concentrate on local or Wereda markets to satisfy the demand in these areas.

The emergence of user groups such as the Addis Abeba Dairy producers and marketing Association, the Adda Liben Dairy producers and marketing Association, the Selale Milk Marketing Union, and a number of small scale milk processing groups etc. had now paved the way to rationalize on marketing issue where proper marketing in terms of milk collection, transportation, processing and distribution are the means to enhance production. These would be the basis to the increase the supply of available milk to the consumer and encourage dairy farmers to invest more to benefit from the available resource base.

3. Impact of policy changes on dairy development

Political changes had significant impact on the level and success of interventions in Ethiopian dairy development. Three political changes have been distinguished which are the period of dairy development before rural land proclamation of 1975, the period of rural dairy development of central economic system and the period of smallholder based current phase of structural adjustment programme after 1992. The basic rationale for following the political regimes in identifying phases of the dairy development is that during each of the phases the country had and still followed a distinct political path and associated policies such as land tenure and land policy, macroeconomic policy and orientation of development efforts that directly and indirectly influenced the development. Based on Data from FAO Production Year Books milk production levels have been used to evaluate the performance in each of the phases.

During the Imperial period, which is up to 1974, milk production had increased significantly by 19.5% from 1961 to 1972 at an average growth rate of 1.62%. This growth was largely due to economics of scale in production as well as marketing, subsidy in transport to the formal market, secured land tenure and free market for feed and other inputs (Staal et al, 1996).

During the Socialist regime, command economy, milk production had shown short progress. From 1978 1980 total milk production increased at high rate and there was a steady decrease then onwards up to 1990, following the drought of 1984. It was reported that the declining trend in milk production

during the period 1986-1990 was largely attributed to severe misdirection of efforts towards state farms, emphasis given to cooperatives and lower producer prices that were discouraging production neglecting the smallholders and urban dairy producers. However, despite the sharp decline in milk production, butter production and cheese production has increased significantly from 1974-1990, which shows a change in market outlet preferences of producers and the improvement in the retail price for dairy products.

Milk production from 1991-2001 had grown during this post reform period at annual rate of 2.19% (FAO, 2001). During this period a reform in market oriented economic system dairying had exhibited a change in its emphasis. Some progress in whole milk price had been exhibited that encourage producers to become more involved in dairying. Major events were, the devaluation of the currency, a new land policy on temporary lease declared and policy on agricultural led industrialization,

Despite the interventions made to develop the sub-sector production had failed to keep up with population growth. Milk consumption has generally remained low with a tendency to decline. The traditional sector which involves the greater part of the poor sector of the population and which accounts for over 90% of the milk production, appears to have received modest attention by contrast. Improvement of native breeds of cattle by selection and cross breeding has been limited and local market development has rarely been organized. Efforts to develop smallholder/small scale production being made but the intensity of such efforts has generally been somewhat limited.

III. CURRENT SITUATION

A. THE POLICY ENVIRONMENT

Early policies endorsed by the Government related to dairy development includes Proclamation to provide for the control of Animal diseases of 1941 revised in 1955 and 1961, Order for the establishment of the Institute of Agricultural Research of 1966 later restructured into the Ethiopian Agricultural Research Organization in 1995, Order for the establishment of Dairy Development Agency of 1971, Proclamation for the establishment of Joint venture of 1983 and Investment Proclamation of 1996, amended in 1998. Recent policy on animal health includes the proclamation to provide for the Prevention and Control of Animal Diseases of 2002.

Development efforts on dairying with implementation of programmes and projects within livestock sector or on dairy sub-sector were based on reviews and the Government Five-Year and Annual Plans on purpose and area specific dairy strategies. In the 1980's the livestock Sector review and the Ten Year Perspective Plan on livestock Development had given emphasis and directions on dairy development through underlining the state, cooperative and smallholder involvement. Further, the Ruminant Livestock Strategy had directions on the development of the sub-sector by preparing the strategy under the two ecological categories and classifying the constraint areas in animal breeding, health, animal nutrition and marketing. The National Livestock Development Programme developed in 1997 also served as a base for the implementation of the National Livestock Development Project, which has components in the constraint areas - namely improving breeding, forage development and capacity building of veterinary services.

1. Process of policy making

The Ethiopian Government policy ratification is the responsibility of House of Peoples Representatives of the PDRE (the Parliament). Draft policy documents prepared by the different institutions and legal bodies mandated to handle the case have to go through a series of reviews to

streamline the effectiveness, identify the duties and responsibilities of stakeholders and the considerations in the legal, institutional and development perspectives of the issue before it is finally endorsed by the Assembly.

The drafted policy, provided that it has been discussed and endorsed with concerned stakeholders, is forwarded to the Council of Ministers for review and consideration on a national perspective and prioritization. The reviewed document will then be submitted to the House of Peoples Representatives for further review. There, public opinion will be gathered with the presentation of the document at a general forum, which will be called together by the committee that is responsible for the sector in the House of Peoples Representatives. Approval of the policy will be made at the final discussion on the Assembly and will be gazetted as a proclamation.

2. The level and extent of current policy implementation

The low performance of the agricultural sector in the past, which is also true for livestock and especially of dairying, was reflected in the declining food supply, inability to absorb the growing labor force, incapability to provide markets for the domestic produced goods, inability to supply raw material to the manufacturing sector, poor macro economic and sectoral development, etc. Realization of more rational policy measures should be instrumental in efficient allocation and utilization of resources to enhance productivity of the sub-sector and socio-economic development.

Specific policy measures in terms of macro-economic and structural reform measures had been undertaken by the Government since 1992/93 (MOA, 2000). Among the policy reforms made in Ethiopia those that affect the development of the dairy sub-sector are.

- Security on land use rights and elimination of restrictions on renting land and hiring labor
- Liberalization of agricultural output and agricultural input prices
- Elimination of market control for agricultural exports, adjustment of tax and tariff structures
- Encouragement of private sector to participate in farming, marketing and distribution of inputs
- Strengthening efforts to improve rural roads and farmers access to market
- Improving of delivery of support services to the livestock sub-sector
- Monetary reform

In addition to the short and medium term policy measures taken to bring economic stability and create conducive environment for growth, the Government had designed long-term strategies namely the Agricultural Development Led Industrialization (ADL), Rural Development Strategy and Poverty Reduction Strategy. The Agricultural Development Led Industrialization strategy focuses primarily on agricultural development with the objectives of attainment of food self-sufficiency, improvement in the quality of life of the rural population, through employment creation, poverty reduction and improved nutrition and reversing ecological degradation, and is planned to be achieved through improvement of productivity in smallholdings and expansion of large-scale farms, particularly in the lowlands. The Rural Development Strategy focuses on the use of available resources for maximum production on market-oriented development of the different product sub-sectors through packages of technology and human resource development.

3. Current policy framework

The Ministry, based on the early agricultural policies and programmes and the Rural Development Strategy, has prepared an Agricultural Development Policy incorporating livestock as part of the policy document. The policy document has seven sections on rural land use and administration, soil and water conservation, forestry, wildlife management, crop production, livestock and cross-sectoral

policies. Dairy, meat, poultry, fishery, beekeeping, pack animals, camel, hides and skins, wool and hair, feeds and fodder, veterinary services, pastoralist development and animal welfare have been treated as sub-sections of the livestock section of the draft policy.

Policy instruments on the dairy sub-sector, which are included in the draft Agricultural Policy document include increased use of high milk producing animals through improvement and introduction, improve services in extension, veterinary and breeding, introduction of appropriate technology based on stratification of the country for dairying, development of marketing structure to increase output and produce quality and healthy milk and dairy products etc. The policy, it is hoped, shall also stimulate and facilitate sustainable dairy market development

A draft policy framework for dairy development has also been developed and is under review. The overall policy objective of the dairy is to develop and utilise the available resources and increase its contribution to the social and economic development of the country. The specific objectives are to ensure self-sufficiency in milk and dairy products, improve the nutritional standards of the population through the domestic provision of high quality, protein-rich dairy products, improve the incomes and living standards of farm families, create employment directly through investment on dairy, generate foreign currency through reduction of imports of milk and dairy products, encourage the production of necessary raw material inputs for the dairy industry, provide milk and dairy products at affordable price, conserve and improve the indigenous breed characters (Getachew and Gashaw, 2001).

As liquid milk market is dominated by an informal marketing system and demand for milk and its products is increasing, as milk production takes place mainly in rural areas and in a country where the economic base is the rural community, improvement in milk and dairy products marketing is considered crucial. The need to create links between the rural producer and the urban consumer then highlights the use of appropriate milk marketing policy. The objectives and strategies milk marketing policy as sighted in draft dairy policy document is summarized as:

- Improve the efficiency of the milk and dairy products marketing through strengthening and establishment of marketing infrastructure
- Set up dairy marketing organisations (private, co-operatives, parastatal) to secure economics of scale in collection, processing and distribution and promote and encourage the establishment of voluntary farmers co-operatives
- Licence, inspect and regulate competitive trading organisations so as to ensure compliance with minimum standards as to price, hygiene and quality
- Use of quantitative import restrictions and tariff protection
- Develop and promote the technology of improving the efficiency of traditional butter making
- Promote and facilitate the establishment of small scale dairy processing units;
- Develop quality control services and improvements in quality and hygiene;
- Promote applied research on preservation of milk and dairy products and render extension services for the adoption of the technology;
- Provide effective training on marketing, processing and preservation of milk and dairy products;
- Promote and facilitate market information services
- Provide credit facility for expansion of dairying and small scale processing

Currently preparations are underway to develop the Ethiopian Dairy Master Plan through a Steering Committee composed of the Ministry of Agriculture, the Ethiopian Agricultural Research Organization and International Livestock Research Institute.

B. INSTITUTIONS IN DAIRY DEVELOPMENT

There are a number of Institutions responsible for the different activities in dairy development The major stakeholders include the Ministry of Agriculture, the Ethiopian Agricultural Research Organization, Dairy Development Enterprise and the Livestock Marketing Development Authority. The International Livestock Research Centre is also involved in dairy development at a global level.

1. Ministry of Agriculture

Dairy development in the country is generally undertaken by the government of Ethiopia represented by the Ministry of Agriculture, which continues to be the Government's main arm for agricultural policy formulation and technical supervision including designing of strategies, preparation of programmes, capacity building, training and coordinating national development projects. In addition to its position as a setter of policy and its role in regulation and enforcement, MOA's function is more geared to provide technical backstopping in advice and support to the Agricultural Development Bureau of the Regional States where these are increasingly assuming direct responsibilities for managing their own agricultural programmes and budgets and for direct farmer support through their extension services. In the livestock sector, however, MOA retains control of federal responsibilities in animal disease monitoring, vaccination campaign and artificial insemination programmes.

The Ministry of Agriculture under its power and duties is responsible for the overall development of the sector in causing the expansion of agricultural development, encouraging and assisting the provision of agricultural extension services to peasants through technological package development, facilitating the provision of agricultural inputs and credit facilities, establishment and direction of research and training establishments that may assist the enhancement of the development and the improvement of rural technology, encouraging the organization of peasants and the development of cooperatives to a higher level, encouraging agricultural investment, issuing of agricultural licenses and ensuring quarantine control etc.

Two Departments, Animal and Fisheries Resources Technology and Regulatory Department (AFRTRD) and Agricultural Extension Department, are directly responsible for dairy development. AFRTRD is responsible for development of livestock policy, programme and projects and follow up of their proper execution through the concerned departments and sections down the ladder in the area of implementation. The Department is also responsible for the generation of technologies developed through research and development processes in verifying impacts and follow up. The Extension Department is responsible for the dissemination of technology by coordinating development of appropriate packages at national level and dissemination of the process through Regional Agricultural Development Bureau. Implementation of the packages are at the Wereda level The power and duty definition of the FDRE had given the Wereda the mandate to administer its own affairs and execute development activities according to its priority listing. This may affect the livestock sector, especially the dairy sub-sector where policy decisions influence the priority be given to the most needed sector of the locality with out consideration of the importance and integration of the livestock to others. The lowest organization for execution of extension is the Development Centre/ agricultural center/ station where Peasants Associations are addressed in manageable sizes to be operated by Development Agents, responsible for integrated agricultural development. The AFRTRD with its Animal and Fisheries Resources Development and the Veterinary services and regulatory Teams are responsible for promotion of technology and development in animal feeds, breeding and health services.

2. Ethiopian Agricultural Research Organization

The Ethiopian Institute of Agricultural Research was responsible to undertake, promote and streamline research in agriculture (crop, livestock, fisheries and forestry) giving more attention to crop production improvement. Under the newly structured Ethiopian Agricultural Research organization, Proclamation 1997, livestock production in general and dairy production in particular had gained attention.

EARO has been structured to include five Directorates in Agronomy, Livestock, Natural resources, Arid Land Agriculture and Administration. At national level it has the mandate to run research centers of excellence including Holeta, Debre Zeit and Melkasa and coordinate on commodity basis the activity of Regional Research stations through their respective offices. There are four Regional Agricultural Research Offices in Amhara, Oromiya, Tigray and SNNP. Other Regions control their respective research stations are under their respective agricultural development Bureau.

The Animal and Fisheries Research Directorate is responsible for dairy research. The major activity of the directorate on milk research is on cattle milk, which had been given high priority. Other areas like milk from small ruminant and milk from camel are part of the research agenda in the respective research programmes. Dairy development, cattle milk research had gained commodity status and considers agro-ecological variations of the country as a media in identifying needs and researchable technologies. The dairy research had been reoriented to take a multidisciplinary approach by constituting eight sub programmes namely animal breeding and genetics, husbandry and management, feed resource management, animal nutrition and physiology, animal health, dairy processing technology, socio-economics and technology transfer. The research undertakings would be carried out on-station with strong linkages and support by on-farm verifications.

Holeta Research Station serves as a center of excellence for dairy research and major research activities are run at Holeta and Debrezeit stations. The center coordinates all dairy improvement researches at the different regional and other stations including collaboration with agricultural universities and colleges.

3. Dairy Development Enterprise

The Dairy Development Enterprise is a commercial institution responsible for overseeing the state dairy development in running the state dairy farms and operating the Shola milk processing plant. The Enterprise renders services to milk producers and consumers in and around Addis Abeba in collection, transportation, processing and marketing of the milk and dairy products. Milk collection is carried out with a number of centers along the five routes of the city. It operates also six of the 13 milk chilling centers and five marketing facilities in the city.

The overall responsibility for Dairy Development Enterprise decision-making body/process lies with the Board while the General Manager and his subordinates serve as an executing body. There are four Departments and four services organized to run the day-to-day activity of the Enterprise. The technical Departments include Milk Processing Department, responsible for the processing and industry maintenance, Commerce Department for purchases of inputs and sale of products and Production Department for raw milk purchase and running of the dairy farms. Quality control is a service for routine follow up of checking milk delivered at the plant

4. Livestock Marketing Authority

The Animal, Animal Products and By-products Marketing Development Authority was established under Proclamation 1998. It was amended by proclamation 2000; thereby named as Livestock Marketing Authority, as an autonomous Federal Government body having juridical personality.

The Livestock Marketing Authority with its mandate of promoting import and export of livestock and their products is responsible for the promotion of trade including live animal, milk, meat, and other products, setting proper regulations and guidelines of marketing and follow up of its execution according to set standards and compilation and dissemination of market information both at local and

international level. The powers and duties of the Livestock Marketing Development Authority pertaining to dairy include

- Initiate policies, laws and regulations to promote animal products and byproducts marketing and upon approval devise means for follow up and supervise their implementation
- In collaboration with concerned bodies issue quality control directives on exportable and importable animal products and byproducts and follow up their trading activities
- Issue criteria that ought to be fulfilled by domestic import and export traders engaged in animal products and byproduct trading and provide information to the concerned bodies
- Collect, analyze and disseminate information on the current demands and international animal, animal products and byproducts market situation to producers, domestic and foreign consumers and traders

The Authority is structured into two technical and three support services. The technical include Quality Improvement and Control Department and Market Improvement and Promotion Department. It does not have any branch offices at regional or any strategic locations pertinent for livestock marketing for both domestic and international markets.

C. DAIRY PRODUCTION SYSTEM AND ESTIMATE OF QUANTITY OF MILK PRODUCED

In Ethiopia milk is produced in all agro-ecological zones, though productivity and significance varies, from cows, does and camel. Ewes are also used for milk production especially in pastoral areas. Generally cattle produce about 81.2% of the milk. The remaining amount (16.6%) being produced by other species of livestock namely camel and does (Getachew Felleke and Gashaw G., 2001). Smallholders using indigenous cattle produce 97 % of the milk. The rest is produced from grade and exotic cattle in the peri-urban and urban production system.

1. The Ethiopian milk production system

The Ethiopian milk production system, based on agro-ecology characterization of the area, socio-economic structures of the human population and the species of livestock and type of breed used for milk production can be distinguished by five categories, the traditional pastoral livestock farming, traditional highland mixed farming, the emerging smallholder dairy farming, urban and peri-urban dairy farming and the specialized commercial intensive dairy farming (Getachew Felleke and Gashaw G., 2001). The production system can also be classified using milk marketing as a criterion into urban, peri-urban and rural (Muriuki and Thorpe, 2001). Mekasha (1999), based on a different approach (on farming systems, the principal ecological zones and the underlying livestock production systems) had identified five systems of livestock/milk production in sub-Saharan countries namely Pastoralism, Agropastoralism, Mixed farming, Intensive dairy farming and Peri-urban milk production, which are also applicable to Ethiopia. However, for the purpose of this paper the production system categorized based on the first criteria is used.

The pastoral areas extend from the northeast Afar lowlands to the western lowlands of Benishangul Gumuz including the southeast (Somali Region), southern (Borana) and southwest (Southern Omo). Milk production is the major activity as food and income source, where the livelihood of the semi-nomadic transhumance population is dependent on livestock. Cattle dominate the population (55.4% of the TLU) followed by camel (15.3%), goats (13.7%) and sheep (6.4%), (Coppock, 1993). Of the estimated 5,120,246 cattle (1999) cows constitute 38% of the herd, which indicates that the pastoral people consider cattle primarily for milk production. Small ruminant and camel milk are also important in this area where flock sizes of 65.7% for goats and 67.9% for sheep have been reported to be females.

These may be used for milk production. The lowland accounts for 27% of the milk produced (Getachew Felleke and Gashaw G, 2001). Because of the erratic rainfall pattern and related reasons resulting in shortage of feed milk production per unit is low and highly seasonal. More milk will be produced in the wet season where pastoralists would mostly conserve (in Borana as Ititu) and convert the surplus milk into butter and trade off with the highlanders in the peripheral markets for grain.

The highland area can be regarded as a mixed farming system the feature of which is crop and livestock are interdependent. The highland smallholder milk production using indigenous cattle is the predominant milk production system. Though the majority of the system's cattle and milk production are composed of the local Zebu, very few of the nation's crossbred cattle are believed to account for much of the milk production in the mixed farming system. Cattle constituting 72.4% of the total TLU dominates the population with 28% cows of which 40-45% are on milk each year. Milk from cattle in the highland contributes 78% of the total milk produced. Oxen comprise 27% of the herd indicating the significance given for oxen as source of power in crop production and the main purpose of keeping cattle. The traditional highland smallholder milk production system is further classified into the northern and central highland mixed farming zone, and the southern and western highland mixed farming zone based on their distinct crop farming pattern, feed availability and livestock disease prevalence. Milk is considered as a byproduct of oxen production although in a lot of cases it can be an important source of cash income when sold fresh or as processed products such as butter and cheese. Milk from the traditional sector is produced mainly for subsistence farm household requirements. Here it is used widely for home consumption and converted into butter. Productivity of indigenous breeds for milk is low as a result of their inherent low genetic potential associated with poor traditional management. However, due to large size and dependence of the smallholders on use of cattle this will continue to dominate the production sector especially in rural areas.

Smallholder dairy farming has been introduced with the introduction of crossbred dairy heifers into the mixed farming system. This development of an integrated agricultural production using improved stock has proved successful in the highland regions of Ethiopia. The system is mainly located in the potential highland areas of the country where farmers in the peri-urban and some rural areas not located too far from urban centers practice market oriented milk production. They tend to be developed mainly in the Addis Abeba milk shed area and some other urban centers where a market for fresh milk is readily available. Due to limited land holding of the smallholders and the need to complement the crop production in increasing efficiency of agricultural production, the emerging smallholder dairy farming using crossbred and improved dairy stock will continue as important features in dairy development. The expansion of the system is possible in milk shed areas centering urban areas radiating 5-10 km from the urban areas where a market is and will be readily available.

Urban and per-urban milk production has developed in and around major cities and towns, which have high demand for milk. The system comprised small and medium sized dairy farms using crossbred and grade dairy cattle. Herd sizes are small due to urbanization (town dairy with usually less than 5 milking cows) and land size limitations and economic capacity. Whole and un-pasteurized milk is used mainly for sale where steady a market is available for house-to-house milk marketing.

The specialized dairy farming and intensive dairy farming are concentrated in the central highland plateau. Milk and dairy products are produced on a commercial basis. The commercial sector is mainly based on the use of exotic breeds or their high grade crosses. Currently the commercial sector consists of state farms and a number of private medium and large scale producers in the peri-urban areas. Due to privatization of the state dairy farms and liberalization of the economy the sector is dominated by private holdings. More farms have now been developed in and around major cities and towns with a human population of more than 10,000 to cater for high demand.

Generally the traditional system of milk production, involving the mixed smallholder farming community and agro pastoral population, prevails in the country. It is also this system that provides milk and dairy products to urban consumers and the nation at large through the informal marketing system. Due to high population involvement and the potential in milk production, especially the favorable environment and the potential resources in enhancing productivity, this small scale market-oriented dairy system has an opportunity to expand and therefore, should be the focus for development.

2. Estimate of Milk production

Annual milk production increases in Ethiopia can be characterized as low showing no significant progress over the years although there are periods which had indicated some progress. In the period from 1961 – 1972 milk production from all species had grown by 19.5% (a significant increase from 637,375 metric ton to 761,360 metric ton) at an average steady growth rate of 1.62%. This was followed by a decline in 1973-77 and a significant increase from 1978-80. Indication of decline in total milk was observed from 1980 onwards, the lowest being in 1984 when there was severe drought. From then onward changes were not significant with slight increases, the highest being 1986. There was also production decline between 1986-1990. A faster growth rate was reported from 1991-1999 with 2.19% increases annually (referred to Anon, based on FAO Production Year Books). Most of the factors attributed to growth in milk production, however, were due to increases in herd/flock size than improvements in productivity.

According to ILRI (ILRI, 1995) total production of fresh milk from the indigenous livestock in the country had shown a 2.4% increase in growth rate between 1975 and 1987. Annually the respective growth rate for cattle, ewe, doe and camel milk yield indicated to be 2.8%, 0.1%, 1.0% and 1.2% respectively. In general, total production of fresh milk in the country has shown a 0.7% rate of growth annually during the reporting period.

Years 1985-1992 had 1.3% annual growth rate of total milk (ILRI, 2000). The respective growth rate for reporting periods indicate that cattle, ewe, doe and she-camel milk yield had increased by 1.65%, 0.5%, 0.25% and 1.6%. The National Livestock Development Programme (MOA, 1998) indicated an estimated 2.19% annual increase in total milk production from the indigenous livestock between 1987 and 1995 in which there is significant difference with ILCA in the same period.

Total milk production from cattle, goats, camel and sheep for year 2002 was estimated at 1,328,285 tons with annual growth rate of 1.3% (MOA, 2000). From the total produced the indigenous livestock milk production contributed about 1,197,700 tons (Table 4 and 6). The contribution of the different indigenous livestock species to the total production is 81.2% from cattle, 6.3% from camel, 7.9% from goats and 4.6% from ewe (MOA, 1999).

Table 4: Estimated milk production from indigenous livestock, (amount, source and growth rate)

Description	Milk Production (000 ton)			Contribution (%)	Annual Growth rate (%)
	1993	1989	2000		
Cattle milk	915,500	926,800	972,800	81.2	1.65
Sheep	54,400	54,500	55,000	4.6	0.50
Goats	92,900	93,000	94,300	7.9	0.25
Camel	73,700	74,100	75,600	6.3	1.60
Total	1,136,900	1,148,400	1,197,700	100	1.30

Source: MOA (1999)

The range of milk yield per cow per lactation used in estimation of production are the lowest limit as reported in most research outputs, which are 208-210kg from indigenous cow from 120-150 days, 1,500-1,625kg for crossbred cow and 3,725 –5,000kg for grade and pure dairy cow. These figures are far less than the average production of high yielding breeds and even less than the African average.

Milk productivity averages per cow per lactation for the world and Africa is estimated at 2,090kg and 475kg respectively. However, with research indicating that if proper technology is employed to use the existing high population of livestock and potential land and environmental resources an increase of 4 to 5% in milk yields per generation is indicative for possible enhancement of production.

Table 5: Estimate of total number of cows, cows on milk and total number of female herd of indigenous and improved dairy cattle (1999/2000)

Herd category	Breed			
	Indigenous	Crossbred	Grade and pure	Total
Total Cows	10,872,550	11,840	55,520	10,939,910
Cows on milk	4,976,830	8,900	34,640	5,020,370
Total female herd	21,596,590	32,205	124,960	21,753,755
Total cattle	35,032,240			

Source: Getachew Felleke and Gashaw G, 2001

Contribution of indigenous cattle to total milk production is high (Table 5). For instance, year 2000 (1,328,232 tons of milk produced) indigenous caws dominate with estimated 4,976,830 population followed by crossbred (8,900) and grade and pure dairy (34,640) (Getachew F. and Gashaw, 2001). The following table shows projections of estimated milk production and availability for 1995-2025.

Table 6: Estimate of milk production with existing stock (Tons)

YEAR	1995	2000	2005	2010	2015	2020	2025
Crossbred	12,873	13,585	17,139	22,747	30,307	40,973	54,834
Grade	72,925	117,000	198,785	332,731	571,672	1,022,195	1,815,498
Total improved	85,798	130,585	215,924	355,478	601,979	1,063,168	1,870,332
Local cows	915,874	972,781	1,031,940	1,095,442	1,162,625	1,234,068	1,277,613
Goats	92,854	94,291	94,291	95,239	95,716	96,195	96,677
Camel	73,751	75,568	77,476	79,432	81,438	83,494	85,602
Sheep	54,444	55,007	55,282	55,559	55,838	56,118	56,399
Total Local	1,136,923	1,197,647	1,258,989	1,325,672	1,395,617	1,469,875	1,516,291
GRAND TOTAL	1,222,721	1,328,232	1,474,913	1,681,149	1,997,596	2,533,043	3,386,624
Imports	24,565	25,818	27,135	28,519	29,974	31,503	33,110
Total with import	1,247,286	1,354,050	1,502,048	1,709,668	2,027,570	2,564,546	3,419,734
Per caput product	22.37	20.92	20.19	20.14	21.13	23.90	28.80
Capita with import	22.82	21.33	20.56	20.48	21.45	24.19	29.08

Source: Getachew Felleke and Gashaw G, 2001

The national goat breed survey had indicated low milk productivity of indigenous does. Data show that highland goats produce more kids than Afar but have lower milk yield (19 kg in 12 week lactation) and this was increased to 52 kg in half bred Sanaan does. Similarly, Somali goats in the first 6 weeks of lactation gave 40.6 kg of milk as compared to 125.3 kg for the pure bred Anglo-Nubian goats managed similarly. Improved goat, quarter-breed Sanaan produced 30% more milk than the pure bred Adal, 31 and 24 kg milk in 12 weeks lactation, (EARO, 1999). In the lowland Borana milk from does was estimated at 47kg per lactation where breeding females comprise 45 to 50% of the flock (Coppock, 1994

Available data on camel milk production indicate that milk yield from Afar camel is estimated at 2,442 kg for 365 days lactation (Knoess, K.H, 1996). It is also reported that milk from camel averages 7.5 Kg, 11.5 kg and 2104 kg daily, peak and lactation yield respectively from 282 days lactation (EARO, 1999).

The importation of large volume of milk and dairy products in the form of food and commercial imports to meet the local demand indicate that domestic supply short falls. According to Staal (1993)

imports grew at the rate of 15.41% between 1978 and 1989, with commercial imports growing the fastest at 24.18%. This raised the share of commercial imports and dairy consumption from 0.3% to 2.3%. Further data on imports indicate increases in trend, which gradually is reduced due to low amount of milk powder donations. Annual imports in the years 1978/79-1984/85 ranged between 3,256 and 9,473 tons and peaked up again to about 40, 000 tons 1985-88 (Belachew, 1990). It was reported also that when per capita milk production was 21.9 kg the share of import was 1.7 kg (Walshe, 1991). Imports of milk and dairy products between 1988/89 and 1997/98 averaged 1975.6 ton of milk and 139.5 ton of dairy product worth 19,123,927 Birr (Data from Ethiopian Customs Authority, 2003). Annual trends in import of milk and dairy products for years 1988/89 to 1997/98 is given in Annex 1. It can be concluded that, as indicated in Debrah and Anteneh (1991), the inability to maintain the per capita production levels points to significant weaknesses in the milk production and marketing system as it lies well below the potential that exists.

D. The Ethiopian Milk Marketing system

Both formal and the informal milk marketing system exist in Ethiopia. The formal milk marketing system is dominated by the government controlled Dairy Development Enterprise (DDE) which functions as a milk producer (currently due to privatization this activity is not significant), collector, processor and distributor. The informal market dominates the system and involves direct delivery of fresh milk by producers to consumers in the immediate neighborhood and individuals in nearby towns. Both commercial (urban and peri-urban) and smallholder (rural) farmers use the formal and informal channels to sale milk and dairy products. The smallholder milk marketing system can also be characterized as traditional, urban and peri-urban, commercial and small scale milk processing units depending on type of the produce and the intended end product that will be available to the consumer (Bennett, 2001).

1. The formal market

With overall objectives of development of market outlets for locally produced milk, price stabilization, and safeguarding consumers through supply of hygienic and wholesome dairy products interventions to formalize dairy marketing had been in place since 1947. However, in relative terms the dairy marketing infrastructure including collection networks, chilling facilities, processing plants and distribution outlets did not developed with the pace expected of population growth and the need to supply adequate quality and hygienic milk and dairy products to consumers.

In the formal marketing system, dominated by DDE and Mama, processing plants obtain milk either from their own farms or collections from commercial farms and smallholder farms in peri-urban and rural areas from indigenous and crossbred cattle. As reported in AACM (1985) a significant proportion of milk supplied to DDE was collected from smallholders where the State dairy supply was 48%, large and medium scale private farms and small holder farmers contributed l5% and 37% respectively.

To date milk processing plants in Ethiopia are very limited in number and capacity. The main are Shola Dairy plant run by DDE, Mama dairy run by Sebeta Agro Industries. Milk collection, chilling and processing through the formal channel is practical by only these two plants In addition to milk pasteurization these plants may also produce butter and cheese (hard and soft cheese or Ayib). Small scale milk pasteurization plants existed in Alemaya University, Zwai Children's Village (Amba), DireDawa (Hamdael) and Awassa SOS. The status of some of these plants is not known. It is estimated that the market share of the official sub-system does not exceed 18 percent (Staal, 1992).

ARDU had established a processing plant at Asela and organised milk collection network for participating farmers following the distribution of crossbred heifers. Although the system encouraged

dairy development in the area it was discontinued because of poor conditions of milk collection fleet; frequent breakdown of processing equipment; and relatively low and fixed liquid milk price payment.

2. The informal market

In the rural areas liquid milk is marketed only when farmers are within traveling distances of urban centers where they have opportunity to sell privately to the urban dwellers or institutions. The Marketing of smallholder milk is primarily through the informal market, which involves direct delivery of fresh milk to consumers in the immediate neighborhood and sales to itinerant traders or individuals in nearby towns.

Although quantification is impossible, rural milk sale is low estimated at 5% (AACM, 1985). On the other hand urban areas have a concentration of population, institutions like schools, colleges, hospitals, factories, etc. where the demand for milk is high. In these areas individual farmers, milk marketing cooperatives, commercial farmers and state dairy farms have no problem of disposing their milk in the formal channel as well. However, due to low intake of the formal market it was reported that sale of milk directly to the consumer gives a higher return than delivering to DDE, which had forced producers to incline towards the informal sector.

In the highland peri-urban dairy farming system both formal and informal are functional. The informal marketing sub-system dominates where producers directly sell to consumers. According to Bennett (2001), the informal market has three sub systems, the traditional rural practices, urban and peri-urban raw milk sales and the emerging small scale dairy product sales. Traditional rural milk marketing practices concentrate on their surrounding areas of walking distance radius. Producers generally have private agreements called “contracts” which are verbal agreements whereby they provide 1/2 to 1 liter to private households or larger quantities to hotels or bars in the local area. Urban and peri-urban raw milk supplies cater for urban consumers. Both formal and informal are responsible for the collection from producers and supply of milk to consumers, the informal dominating in intra-urban and the rural. The balance of the milk is supplied to formal depending on the sustainable collection programmes of the collectors at farm gate or collection points. The informal supply is higher in all the regional towns where milk is not overtly marketed and is generally supplied through a direct contract agreement between the farmer and households or businesses.

In the lowlands, milk is sold through the traditional methods where women or children directly sell to consumers travelling long distances in the hot climate. Market access in the lowlands is a critical factor in dairy marketing. Those pastoralists, who reside closer to towns, though distances matter, have the advantage of selling liquid milk as compared to those households living in far away places. A study by FLDP and ILCA (1986) carried out in Borana area had indicated that the type of marketing, the distance to market, season and family wealth in dairy sales are main indicators that determine the sales of milk and dairy products and the contribution to pastoral cash income. This study best explains the marketing system, which is also true for the other lowland regions of Afar and Somali (Holden, 1989). It reported that households residing within 30 km of market outlets usually sell butter and fresh milk products. Butter tends to be sold more by wealthier households further from market while fresh milk is sold relatively more by poorer families residing closer to the market (Holden S.G. and Coppock D.L., 1995). The milk and dairy market situation as documented in the study is summarized as follows:

- Households located within 10 km of market sold twelve times the quantity of dairy products as compared to households 20 to 30 km from market.
- Dairy product sales were higher in the wet season declining by 83% in the dry season.
- Poor households sold 85% less dairy products than rich households, but their low level of income from other sources made dairy marketing an important supplementary source of income.

- Poor households located within 10 km of market derived nearly 40% of their annual cash income from dairy sales whereas rich households similarly located derived only 22%.
- The capacity by poor families to sell milk reduces the need to sale livestock for grain purchase thereby helping avoid a reduction of livestock capital.
- The income from dairy sales belongs to the women.

From the above facts it is evident that milk and dairy products marketing in the lowland pastoral population had potential for if developed in sustainable approach.

The bulk of butter and Ayib in the highlands are channelled through the informal market. Farmers, mainly women, take the products weekly or monthly to rural market places or sell at farm gates to traders /brokers who then accumulate it and pass it on in bulk on to licensed butter merchant who transports it to more distant markets mostly to Addis Abeba by truck in bulk of up to 4 or 5 tones per trip. A wholesale butter market operates in specialized groups according to specific regions reputed for specific qualities. Brands like Sheno, Welega, Gojam, and Welaita are some of the best known with unique quality.

As part of promoting marketing small scale rural processing, user's group processing units have been established and expected to contribute much to the efficient butter recovery using a less time consuming procedure and sanitary situation than traditional butter making.

In areas where smallholder farmers are located closely and the amount of milk production is justifiable to establish milk collection and processing unit's involvement of the organization of farmers or groups had created another system of milk marketing. There are two types of group activity the dairy marketing cooperatives and milk processing user groups. The best examples for the respective types are Adaa Liben type of milk marketing cooperative and Selale type of milk processing user-groups and their union.

Establishment of small scale dairy processing user-groups was started since 1991 with DRDP as part of its product diversification to promote marketing in cooperative dairy farms. Ten Cooperative dairy farms in Hararge, East Shewa, Welega, North Shewa and East Gojam were among the first with established milk processing. This did not continue due to destabilization of cooperatives. Formation of user groups like Bakelo (North Shewa), Small scale milk Marketing Project (MOA/FAO/WFP) in Arsi and South Shewa and 23 milk-marketing user groups of SDDP (16 in Oromiya, 4 in Amhara and 3 in the SNNP) are among the many processing units established which are operational to date.

3. Identification of stakeholders

Both producers and consumers should be considered as major stakeholders where the producer had the responsibility to supply adequate, clean and hygienic milk and dairy product and the consumer having the right to get milk and dairy product of high quality, safe and free from any disease hazard.

Institutions, farmer's organizations and the private sector will also play a major role in facilitating handling, processing and regulation of the product to be available for proper consumption and for the public to gain adequate nutrition for growth and development. A number of Government Institutions and other bodies are responsible for the different activities in dairy development the major stakeholders include the Ministry of Agriculture, Ethiopian Quality and Standards Authority, Ethiopian Agricultural Research Organization, Science and Technology Commission and Livestock Marketing Development Authority. As a global mandated organization the International Livestock Research Center is also involved in dairy development. On international collaboration and assistance agencies like FAO, UNDP, DANIDA, SIDA, UNIDO, USAID are potential participants.

As a result of efforts made on dairy development there are a number of milk producers and marketing cooperatives and small scale milk processing and marketing user groups organized in the different

regions mainly in Amhara, Oromiya, Addis Abeba and Southern Nations and Nationalities to cater for milk production, collection, processing and marketing. Large numbers of small scale individual processors are operational in Ethiopia especially in Addis Abeba milk shed area who produce/collect and process milk. Enumeration may not be complete but with available data a short description of some of the stakeholders is as follows.

i. Private milk processing

On private sector involvement, as venue for the formal market Dairy Development Enterprise, Sebeta Agro Industries and Dire Dairy Ltd are the main stakeholders. These stakeholders are main actors in the formal milk marketing where the first two involve smallholder farmers to collect milk for processing. Details have been provided in the earlier sections. Hamdael, Dire Dairies Ltd uses his own herd to process milk for supplying homogenized milk to Dire Dawa.

ii. Southern Nations and Nationalities Region

According to Agricultural Extension and Technology Development Department of the Region there are three dairy producer cooperatives and three small-scale milk processing user-groups in the region. The cooperatives, Yetigil Fre (87 members) and Adare (27 members) in Awasa and Dale (10 members) in Yirgalem had a share of 0.6% of the 13,724 Ton total milk produced in Sidama Zone with a daily output of 4150 kgs. The three user groups are located in Leku, Loke and Abosto respectively near Awassa, Yirgalem and Dale with 63 members in total. It was indicated that of the total milk produced in Sidama Zone 60.6% is produced by the 319, 434 rural producers while the rest 39.4% is few urban and peri-urban farmers (SZADD, 2002).

iii. Oromiya Region

Selale Milk Marketing Cooperative Union

The Selale milk marketing cooperative Union encompasses the 11 smallscale milk processing user group established by SDDP and the Chancho milk producers and Marketing cooperative covering the route from Sululta (12km) to Degem (130km) on the Addis-DebreMarkos road. In addition to coordinating the small scale milk processing user groups in processing and marketing the cooperative has 12 milk centers along the main route to collect milk for small scale processing and supply the Sebeta Agro-Industries with, at present, 300 liters of milk daily.

Adaa Liben Milk Marketing Cooperative

Adaa Liben Milk Marketing Cooperative was established in 1990 E.C. (1998) with 34 members and initial registered capital of 3,400 Birr. The main aim of the cooperative was to collect milk from its members and other farms and sell whole milk to urban consumers in Debrezeit and Addis Abeba through retail shops. In its initial establishment Adaa Liben Milk Marketing Cooperative had technical and moral support from the International Livestock Research institute. Training of members on milk handling and processing had been given with financial assistance from other organizations. The growth of the cooperative was rapid that they have managed to establish eight collection centres in and around Debrezeit and Adaa Wereda, the procurement of a mini truck fitted to transport milk to Addis Abeba and owning a smallscale milk separator and churn and chillers. The cooperative had contracted with Mama to supply the plant with 4,000 litres of milk daily. Membership had risen to 543 (295 males and 248 females) with present capital of 684,679 Birr. Annual milk collected had risen from 288,000 litres in 1998 to 1.8 million litres in 2002. It has trained 56 of its members on milk quality control and processing and currently is employing 33 young regular staff. As indicated in their five years performance report of 1999 the cooperative had collected 2.4 million litres of milk in the reporting 18 months (1997-1999). The profit was 290,000 Birr of which 113,189.06 Birr has been distributed to members as dividend. The society has

a project proposal worth 12 million Birr to expand its activity in milk and feed processing and provision of AI and animal health services.

Small scale milk processing user groups

There are 15 milk user groups established by SDDP in addition to Bilalo and Lemu Arya in Oromiya. An additional 14 are under being organized in the different zones of the Region through NLDP.

iv. Addis Abeba City administration

The Addis Abeba Dairy Producers and Marketing Cooperative

This was established in 1991 with the initial objective of rationalizing the feed supply from agro-industries, which was a problem during the period when feed availability was scarce and distribution uneven. It has now taken up the responsibility and promotion of milk marketing and follow-up of the development of dairying for its members. At present it has 252 members of smallscale intra-urban dairy farms of which 104 (42%) are female. The cooperative is running five feed distribution centers in selected areas mainly in the periphery of the city. Milk sale is also being carried out in four sites and there is a plan to establish an additional 12 centers to cater for whole milk sales. The cooperative had commissioned studies to develop feed processing and milk processing plants; had submitted a proposal to the city administration to acquire land for farm development for its members, processing and distribution centers in strategic areas of the city, which will properly be sited according to the master plan of the city. The need for collecting milk from its members to have a steady outlet, sanitized milk collection and quality control by establishing milk sale is considered as their main aim. In the near future this is hoped to provide benefits for the producers with increased income and the consumers by the provision of high quality and healthy milk daily. Some farms are not members of the Cooperative, especially those large-scale farms in the peri-urban areas of Addis Abeba.

Urban and peri-urban smallscale milk processing

Dairy farms in the urban and peri-urban areas are not catering only for raw milk supply to the city dwellers. There are also small and medium scale farms that practice milk processing to produce dairy products mainly during slack season in raw milk outlets especially during the fasting months. Processors with proper dairy products manufacturing, mainly concentrated on butter and cheese production. Some produce hard cheese and some supply cream to pastry shops. Table 6 shows the number of processors and their prime production level in the Addis.

Table 6: Number of small scale milk processors in Addis Abeba

Zone	Number of milk processors	
	Small scale	Medium and large
II	18	2
IV	20	2
V	24	3
VI	12	2
Total	74	9

Compiled from data of Addis Abeba City Administration Agricultural Development Office

v. Amhara Region

Twenty small scale milk processing user groups are established in Amhara Region where 11 are currently operational. The remaining three have discontinued and the rest are new. Among the functional small scale milk processing two are in North Shewa, six in East Gojam, one in Awi, one in North Gondar and one in West Gojam.

vi. Tigray Region

Two dairy farms run by SOS and Tigray Development Association have plans for small scale dairy processing facility in Mekele town (Personal communication). Establishment of seven small scale milk processing units is underway where sites are being selected and farmers organized.

vii. Small scale milk processing units

The NLDP in its activity under its Livestock improvement component will establish 200 small scale milk processing units in the different parts of the country where dairy development activity using improved technology in terms of heifer distribution, artificial insemination and feed development had been implemented. The basic components of the small scale milk processing intervention are provision of milk separator, improved butter churn and other equipment for processing whole milk. These are designed to be implemented in areas away from markets to increase the shelf life, capture the local market and make the product available to consumers in distant markets.

The planned distribution of the smallscale milk processing units that will be established under user groups are given in Table 7. Currently the establishment of smallscale units planned in 2000/2002 are underway and expected to continue milk collection and processing activities in 2003.

Table 7: Planned establishment of small scale milk processing units by NLDP

Region	Small scale milk processing units			
	2000/2002	2002/2003	2003/2004	Total
Tigray	10	5	5	20
Afar	3	2	2	7
Amhara	21	20	14	55
Oromiya	28	30	12	70
SNNP	14	10	8	32
Somali	2	2	1	5
Harari	2	1		3
Benishangul	2	1		3
Gambela	2	1		3
Dire Dawa	1	1		2
Total	83	73	42	200

Source: MOA, 2003

E. POST HARVEST LOSSES IN MILK

The availability and utilization of milk for human consumption in Ethiopia is affected by the inefficient utilization of the available resources, increased post harvest losses and unavailability of diverse milk and dairy products to attract consumers, which affect the existing products for marketing.

Despite the large livestock population and diverse and favorable agro-climatic conditions, milk production from the available resource base is very low. Low potential for milk coupled with the low level of technology used and poor market forces has impacted on productivity of the livestock population. There are indications that improvements are possible with use of appropriate technology using the existing resources, which could result in tremendous increase in production. The impact will be significant in terms of overall production due to the large size of the livestock and human populations involved.

Due to the highly perishable nature of milk and mishandling practices the amount produced is subjected to high post harvest losses. Losses of up to 20-35% have been reported in Ethiopia for milk and dairy products from milking to consumption (UNDP/MOA, 1993). In addition losses due to use of low technology in conservation and transformation to products to extend its shelf life and losses in nutrients recovered are high. Marketing through formal channels had also incurred post harvest losses of milk where proper utilization of the milk in terms of timely collection, transportation, processing and sale are not practiced. Where small-scale farmers are engaged in subsistence production systems conservation losses are large but difficult to quantify. These losses must be minimized to increase the overall volume of milk and dairy products available.

There is a limited variety of milk and dairy products available in the country (liquid milk, butter, Ayib, Ergo etc) for the consumer to select from - which is expected to be best tool to minimize losses and expand marketing. The need for dairy product diversification is also crucial not only in serving as a means to extend the shelf life of the milk but also to make available different products for the consumer and adjusting the supply to the level of demand according to the purchasing power of the population.

Losses in spillage and contamination are high where handling during and after milking are traditional and care is not satisfactory. In the Ethiopian context care at farm level is most important to deter milk quality that affects both losses in quantity and deterioration in quality. The traditional system of milk production had low level of technology in controlling contamination and the spread of microorganisms, which lead to high post harvest losses. Losses during and after milking can be differentiated briefly in the following cases.

- **Lack of proper milking procedure**

The amount of milk obtained from milking animal is affected by the time of milking, presence of the calf, method of milking, the milking environment and the milker. Proper timing is required to get the animal used to the procedure and allow the udder enough time to secrete milk. Frequency of milking and the gap between milking affects total daily yield, which has significant effect on the overall production. Direct loss of milk also occurs by the presence of the calf; although its importance in the milk letdown process of the indigenous stock is significant the amount taken by the calf is high. Use of whole milk also affects the marketable amount where use of milk replacer as calf feed is not practiced. About 17.5- 30% of milk are reported to be left for the calf which otherwise could have been used if complete milking is practiced.

- **Use of milking and transporting utensils**

Utensils used for milking are usually not conducive for proper milking. These lead to losses and increase contamination by bacteria and dirt in and around the milking area. Direct spoilage losses

account for 2-5% due to improper and narrow tipped milking equipment has been reported. Use of gourds, plastic pail and any utensil not dedicated for milking is a good media to harbor microorganisms that could deteriorate the quality as well as safety of the milk. Cleanliness and safe guarding the equipment from contaminants is not practiced strictly. Use of standard milking utensils like stainless steel, aluminum or milk dedicated plastic and keeping the cleanliness of the materials used should be practiced for clean milk production

- **Storage of milk**

Milk as it comes from the udder has a temperature of 37^0C and is void of any harmful bacteria. It may be contaminated at the tip of the teat during milking. This temperature is conducive for all microorganisms to multiply and deteriorate the milk quality in short time. It has to be cooled to a temperature below 4-6^0C to stop the multiplication of the bacteria until it is processed. The tradition in Ethiopia is to consume milk immediately after milking or sour it for use as fermented milk or converted to dairy products, which has less effect on losses. However, milk is wasted due to leaving at higher temperature than recommended either before or after boiling. Further losses incurred are quality losses by storing in unclean storage utensil prone to high microbial contamination. Thus temperature and period of storage are important factors that should be taken care of.

- **Transporting milk**

Milk transportation is usually done by hand-carrying or packing on donkey/horses or using public transport. The type and cleanliness of container used, distance to market, the ambient temperature, the way the equipment is carried and movement of the carrier cause changes in the milk composition and affects the contamination level. The absence of bulk transport in smallholder milk marketing system has a significant effect on the overall milk supply. This risk is minimized in areas where the formal milk marketing is operational, smallscale processing unit are functional in the vicinity and consumers are located nearby.

- **Marketing milk**

Access to market and volume accepted at the market are main factors constraining milk outlet. Despite farmers traveling long distances, the usual outcome is that either part or all of the milk is not sold and the producer has to either sell it at much reduced price or take it back when it will be spoiled. This is frequently reported in the lowland regions due to prevailing temperatures, scattered distribution of producers and prolonged distance to markets.

- **Distribution of milk**

Milk and dairy product distribution centers are not developed to assist in proper handling of the product to be properly stored till it is sold to maintain its value. The location should be easily accessible to the consumer. The practice in the country is house-to-house sale or street milk sale where producers find a steady outlet for their product through a contract agreement. Traveling long distances using inappropriate containers (clean and insulated milk containers) with temperatures high enough to allow microbial growth causes a significant amount of milk to be wasted before it is sold.

- **Preparation of milk and dairy products**

Milk is usually boiled before drinking to improve its quality and safety. This practice is mainly done in urban areas and in rural areas where the milk is used to feed children. The bulk of the milk is then soured by accumulation of the daily surplus in a container either for consumption as ergo or for processing to butter. However, the practice of removing pathogenic bacteria by boiling should take into account the temperature and time for effective treatment of the milk to keep the quality and reduce the risk of contamination. Here losses are high mostly on quality due to high temperature and long time storage. Contamination will be increased if milk is treated at less than

the optimum temperature and for a short duration. Bulking milk is also a threat to quality and rejection of the milk either for direct consumption or processing unless the container used to bulk and transferring equipment is properly cleaned. Due to the small amount of milk produced individually and to avoid deterioration of milk before processing women in Gurage Zone use a group butter processing scheme called "Milk Ekub" where milk is collected from individual members daily into one household and processed by all members in turn. Traditional technologies like "Ititu" in Borana area and "Metata Ayib" in East Gojam are regarded as important means to prepare milk for long storage value. These have to be evaluated for expanded use for their food value and quality to be made known and accepted by other users. Common sources of contamination in the preparation of milk are the equipment, washing water used, air contamination, packaging materials used, and the personnel.

- **Processing of milk**

Dairy products common in the Ethiopian tradition are mainly butter or ghee and Ayib. Smallholder milk processing is based only on fermented milk. This is due to high ambient temperature, small daily quantities of milk produced, consumer preference, the improved keeping quality of fermented milk and the type and capacity of the locally available processing materials and methods used (O'Mahony, 1988). Traditional system of butter making differs from place to place and their efficiency in terms of milk fat recovery and time requirement also vary. A high rate of fat recovery for quality improvement and short time used in reducing women's drudgery are important factors to consider the efficiency. Here the traditional systems of butter making show low rate of recovery (90%) and longer time than the improved technologies (cream separator cum butter churn) and the appropriate technology developed by ILCA (internal agitator). Traditional butter making requires about 21-25 kg milk to produce 1kg of butter with moisture content of 83% and Ayib can be produced from 3.2-4.5 kg subsequent buttermilk (Zelalem and Ledin, 2000). On the other hand butter making using Internal Agitator and improved technology had required 20kg and 16-18kg of milk to produce 1 kg of butter respectively. Hence a loss of about 8-12% milk is reported per kg of butter produced. Total losses would be high considering the large amount of butter produced in the rural areas. Time taken for the use of traditional system should be considered as important in using labour where the women are the actors. Ayib has a limited market command due to the short shelf life and sales are normally limited to short distances from the production area.

Absence of quality control

There is no official quality control for milk and dairy products in the country. As the major outlet of these products is the informal market central quality control may not be effective unless care is taken from production to consumption chain to minimize contamination. Milk cooling centers at the formal outlet had lower bacteriological quality because of lack of quality control over the milk supplied, lack of standard and clean milk transporting equipment and payment was only done on volume rather than quality supplied. If control on composition and cleanliness is high, losses could be minimized as the supplier gains confidence and obtain a steady and higher price for his quality produce.

Religion

Dairy products are not consumed for 176-205 days by Orthodox Christians (52% of the population) during the lent period, Wednesdays and Fridays and a number of short fasting seasons. This is considered as the major post harvest loss where most of the milk is either processed into butter or lost in the product chain. It has a significant impact on amount of milk produced and collected and on dairy prices both at farm gate and retail level.

F. CONSUMPTION PATTERNS AND CONSUMER PREFERENCES

Milk and dairy products, especially butter and Ayib, are a central part of Ethiopian food culture. Milk is consumed either in fresh or fermented (sour) form. Use of milk is for different purposes including home consumption in fresh form and fermented product (Ergo); processing to long shelf life products such as butter, ghee and Ayib. These could be for home consumption or sale.

In the rural highland mixed farming areas, milk produced is used mainly for home consumption. Part of the milk not utilized especially during flush season will be converted to butter and will be sold to traders who transported it to distant markets. In peri-urban areas and rural areas near urban centers farmers use milk as cash generating commodity by directly selling liquid milk, butter and Ayib. A survey by MOA in highland peri-urban areas (AFRDMA, field report) indicate that in most peri-urban areas 74.6% of the milk produced in the area is either used at home or marketed in liquid form while 17.5% fed to calves, 8% churned and marketed in butter oil state and 0.3% is found to be wasted. Specifically in Arsi 38.5% and in Gojam 19% of the milk is converted into butter and marketed as ghee. In Addis Abeba 94.5% of the milk produced in intra-urban and peri-urban areas is marketed in fresh milk form. In Welaita 85% is used for butter making where whole milk is not usually consumed and use of the butter-milk is traditional food which is taken combined with grain flour. In the Awasa area 84.9% of the milk outlet was as liquid milk.

In the rural areas producers are attracted to produce butter because of lack of a market outlet and a low price for whole milk as compared to butter fetching a comparatively higher price. At national level out of the total butter production 80% is used as a food ingredient, the rest being used as cosmetics for hairdressing and other purposes (AACM, 1985). Of the 80% used for food 70% was reported to be used in rural and other urban areas while 30 % is used in Addis Abeba.

Urban milk and dairy products consumption pattern and preferences do not vary much in Ethiopia. Milk supply for the urban population is usually from either own production from cattle reared at household level or purchased from individuals on the street market and from farmers in the peri-urban areas through the informal market. In most urban centers especially smaller towns, residents tend to own a few cows for milk production for home use and some others keep improved stock or indigenous cattle to supplement their income through sale of milk. A survey in Addis Abeba (1992) on milk utilization indicated that most producers (80%) both in intra-and peri-urban consumed part of the milk produced at home. Over half (54%) of the peri-urban producers processed butter and Ayib. However, as the market for liquid milk was readily available only less than 10 percent of the intra-urban producers processed butter and Ayib mainly to meet the family need for these products.

The percentage of producers consuming own milk in fresh or fermented form differs in locations. Intra-urban producers (62%) consumed only fresh milk while 38% preferred 'Ergo' and fresh milk. On the other hand, peri-urban producers (58%) preferred fresh milk and ergo. While 41% consumed milk in its fresh form, most producers (80%) both in intra-and peri-urban consumed part of the milk produced at home during the period under study.

Producers have different patterns of utilization for processed butter. It is either consumed or sold or partly consumed and sold. 60% of those intra-urban producers that processed butter consumed the product at home while 30% partially sold and 10% mainly sold all that was processed (MOA, 1994). The peri-urban producers (55%) consumed part of the butter processed, 24% sold all and 21% consumed what was produced.

Buttermilk, a by-product of the butter making process is usually used for Ayib making for human consumption and cattle feed. The same study show that intra-urban producers (65%) used buttermilk for Ayib making and 25% used for direct family consumption and Ayib making. Peri-urban producers (59%) converted buttermilk into Ayib while 29% of them either consumed the buttermilk or made Ayib.

Most intra-urban producers (68%) processed Ayib to meet their own family consumption needs. On the other hand, peri-urban producers (56%) partially consumed and sold while 21% totally consumed all and 23% sold the product they processed. The study of O'Connor (1991) around Debre Zeit indicated that 67% of the small holders sold the butter produced, about 64% of the rural producers consumed all the Ayib they processed while 36% of them consumed and sold the product.

Milk in the lowlands is primarily used as fresh whole milk for consumption followed by sale to urban centers. This surplus milk will then be fermented for processing into butter. Types of milk storage and use can be either in the form of milk fermented for a short term for $\geq$ 5 days (used mainly for family consumption or butter making). The remaining milk will be stored to be fermented for a longer term for up to 30 to 60 days used as 'ititu' (a social food commonly reserved for guests).

Where there is no access to liquid milk markets, the only available option for preserving milk is converting it into long shelf-life products such as butter, Ayib and cheese. However, even if the market for selling liquid milk is available, decision making for products processing mainly depends on economic factors and meeting family needs for butter and Ayib.

G. PUBLIC HEALTH RISKS

Animal diseases remain as one of the main constraints to livestock development across all agro-ecological zones of the country. Major epizootic diseases such as Rinderpest, Contagious Bovine Pleuro-Pneumonia, Foot and Mouth Disease, Peste Peti Ruminant, Caprine Contagious Pleuro Pneumonia etc can wipe out the entire herds or flocks and threaten the livelihood of farmers. Disease prevalence is not only manifested on milk production decreases due to morbidity but losses of livestock and significantly influences zoonotic situation.

With the introduction of improved and pure breed cattle and intensification, the incidence of diseases like tuberculosis, brucellosis, strepthotricosis and mastitis is on the increase. These diseases of intensification will seriously threaten the expansion of the dairy sector unless a proper strategy for their control is devised based on sound epidemiological knowledge.

If milk is not produced hygienically it can affect the health of many people. Besides being a health hazard, contamination of milk can lead to huge economic losses due to the production of low quality milk and dairy products. The main public health threats hazard due to milk borne disease in Ethiopia are Tuberculosis and Mastitis. Other effects of zoonotic importance are the spread of Staphylococcus, Salmonella, Clostridium and Corynebacterium infestations causing food poisoning, typhoid fever, tetanus and diphteria respectively. The incidence of Tuberculosis is increasing and had wide coverage to be great threat to the nation. Due to incomplete qualitative data availability the incidence of the diseases could not be ascertained in this document. The indirect effect of Mastitis due to milk being a harbor of pathogenic bacteria that can be lethal to human health should also be treated as important. Though epidemiological results are not available other microorganisms are emerging as harmful to human health like bacteria including Escericia colli. Brucella melitensis, Bacillus ceries, Staphylococcus aureus etc. These can be isolated from livestock products consumed directly or derived from livestock products. Aflatoxin from fungi infestation on feed is also creating a problem in milk contamination where its effect is not only on quality but also on disease hazard (Giangiacomo, 2000). The type of diseases, agents, epidemiology, type of products involved and the technologies necessary to minimize the risks associated with the consumption of those products contaminated with the above microorganisms are not documented and are not known in Ethiopia.

The main types of animal diseases and human health problems, which exist in Ethiopia, are specifically known. However, the epidemiological and economics of these diseases have not been sufficiently studied and documented. Implementation of such monitoring programme to minimize the risk of potentially transferring diseases to consumers is important for adoption of sanitary measures which require an in-depth knowledge of the real incidence of food borne diseases, which diseases are transmitted through dairy products, in which product the virulent agents persist after processing, and which provisions are necessary to minimize the risk of the presence of these organisms.

H. Dairy information system

There is no organized dairy information system in the country. In the absence of an organization that caters for dairying and where the responsibility in developing and regulation is scattered through different institutions, information could not be delivered smoothly to have an impact on development.

The availability of recording and herd registration system as well as breed association that are responsible for collection, analysis and dissemination of data on breed improvement and introduction of appropriate technology could have played a vital role as a mechanism to deliver information in technology to enhance productivity. Forums available for dairy technology information in transfer are workshops and seminars that are held occasionally by the different institutions. Initially the Annual National Livestock Improvement Conferences (NLIC) had been a media of communication for exchange of information on research outputs and development efforts. The most pertinent dairy information networking, though it was dealing on all livestock aspects in the country is through the Ethiopian Society of Animal Production (ESAP) which follows NLIC where annual conferences are held through which proceedings on conference outputs and occasional technical documents on livestock production are published and Livestock Newsletters issued. The Ethiopian Journal of Agricultural Sciences (EJAS) also publishes journals bi-annually dealing mostly on research outputs.

Building national dairy information system dealing with dairy commodities, milk production and productivity of animals, milk and dairy products standards and quality control etc in net working the information gap between researchers, producers, consumers and policy makers is vital if proper and steady dairy development is expected in the country. Thus the establishment of a good information system seems to be central to the development of dairying. The advanced information exchange may apply to high-tech oriented institutions and professionals. However, for the producer especially smallholder, applicable means should be sought to narrow the information gap.

I. The Ethiopian Dairy Development –Analysis of the Current Situation

1. Strengths

Milk is produced from cattle, goats, camel and sheep in all agro ecological zones of the country. All agricultural and livestock systems exhibit milk production of different levels, which shows dairy production is an integral part of the overall socio-economic development of the rural population. Ethiopian dairy development is dominated by smallholder dairy farms with large livestock population of indigenous breeds the production of which is subsistence oriented. With the current 35 million TLU of livestock and expected increase of 1.3%, 1%, 0.9% and 1.1% for cattle, sheep, goats and camel respectively and shrinkage of grazing lands in favor of crop production there is a room for intensification of the milk and dairy production, which calls for the introduction of appropriate technology. Traditional food ingredients from dairy are much favored throughout the population regardless of income, though the magnitude varies.

The increase in population (2.9% annually) specially the urban (3.51% as compared to 1.68% of the rural) and improvement in purchasing power would make demand for milk and dairy products to be increased at a high rate not only on quantitative terms but also on quality terms, which include introduction of varied dairy products, high quality and safe milk and dairy products to be available for consumption to all population in the strata.

Introduced technologies have proved that there is room to enhance productivity provided it is implemented with clear vision and using a sustainable approach. Traditional milk conservation methods (Ititu in Borana, Metata Ayib in Gojam etc) and dairy product technologies (butter and Ayib) could be improved in nutrient recovery, time saving (to reduce women drudgery as women are the main actors in milk handling and processing) and on sanitary terms.

Milk is mostly produced in rural areas where milk marketing is a challenge. Still to date the tradition not to sell milk exists in some area, but it does allow sale of butter. Use of butter to generate income had limited milk availability to consumers in some urban areas.

Recent developments to introduce market-oriented rural dairy production (organizing smallscale dairy producers groups) has had a positive impact and showed that that more dairy products could be made available provided technologies are introduced and a market outlet is organized not only through Government or private entrepreneurship but also by making producers themselves involved in marketing through cooperatives or producer/marketing groups. This can widely be applied specially in the highland areas where 74% of livestock population is available, where the cattle population predominates and 83% of the milk comes to provide food, power and other cash for 88% of the human population. Expansion of market oriented dairy development in the lowland pastoral areas is possible in settlement areas and around urban centers provided collection of milk is organized.

The processing plants are working under their capacity. The low performance of the plants had curtailed growth in milk production in Addis Abeba milk shed area which otherwise might have grown. A steady outlet for milk from the rural areas is very essential for market-oriented smallholder dairy development, where decisions on productivity enhancement and budgeting of milk produced for home consumption or sale could be managed for sustainable growth in income and nutritional status of the family.

Smallscale milk processing user groups had served some rural communities in marketing and improving the keeping quality of milk and producing diverse dairy products. These units served farmers around radius of up to 5k-10 km by letting them delivery milk for processing and paying them prices acceptably higher than usual. The Union of Selale Milk Producers Association had also started milk collection for the dairy industry as well as running smallscale processing. The progress of Adda Liben Milk Producers and Marketing Cooperative (having collection centers well scattered around the Wereda, transport by truck, chilling tank utilization, having good bargaining power with processors etc.) arte best examples in the case of assisting producers get access for milk produced in the locality to have distant market outlet.

With the introduction of smallscale milk processing units and milk marketing cooperatives women and girls on the farm, have reduced workload save significant time and labor, which otherwise would have been used for traditional milk processing and taking raw milk to market, which does not guaranteed sale. The positioning of the units close to schools, so that children can deliver milk on their way to school, but yet adjacent to milk production areas is good strategy as it also allows the collection of any by-products (e.g., whey) by the children when returning home (Bennett, A., 2001).

Further more, farmers have been quick to realize the potential in co-operation through the milk unit. The most common example was the use of the milk unit resources (capital or earnings) to affect the

bulk purchase of feed which is the most expensive production input in the dry season. Through bulk purchase a 20-30% reduction in feed purchase price was reported. The farmers have therefore recognized the units as a service center.

2. Weaknesses/constraints

In smallholder dairy using improved stock (large and medium scale dairy in peri-urban and small and medium dairy in urban areas) feed is the main constraint and accounts more than 60% of the cost of production. Dairying in these areas was highly dependent on bought in feeds the available quantity and low quality had affected not only productivity but also the financial returns in investment.

Milk production and processing is traditional with low productivity, nutrient recovery rate, limited availability of range of products and low health safety level. Aggravated by the absence of milk outlet especially in the rural areas the bulk of the milk is then consumed at home in the area produced. The tradition to sell liquid milk is a recent introduction in some areas, where preference for by product utilization like butter for food, cash income and as cosmetics is high.

Milk for urban populations is derived from the intra-urban, peri-urban and rural areas in their order of importance. The source is through both formal and informal market the latter dominating (80:20), the characteristics of which is inadequate quantity supplied, unhygienic and poor quality standards. Post harvest losses are high due to improper milking procedure (milk suckled by calf, spillage, contamination), adulteration (addition of water, usually polluted), storage, absence and/or inefficient market outlet in collection, transportation and distribution and processing (less efficient traditional processing, absence of commercial processing). Quality control at collection points, though limited in number, is poor or non existent to determine the quality and accept milk with a safe microbial load only.

Setting up user groups had been found essential as basic outlets for milk produced in the locality lack the capital for the replication of advanced technology to other rural areas. Milk and dairy product marketing by the user groups is currently limited to local trade and are highly dependent on traders to come, collect and market their products. This limits returns for producers and acts as a disincentive to significantly boost production levels or expand collection areas by the milk unit management.

There is significant fluctuation of demand for milk and dairy products and resultant price changes from wet to rainy season and from fasting season/area to non-fasting times in both rural and urban dairy markets. The amount of milk accepted by the formal market fluctuates (both processing plants) which had resulted in less confidence of farmers to rely on the plants as a steady outlet. The amount of milk sold by the informal milk marketing chain varies not only on the daily sale basis but also on contractual terms. Prices for both liquid milk and dairy products change with season and cultural and religious conditions. As reported by Bennett (2001) there are fluctuations of +/-35% of the standard butter price.

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3. Opportunities

Despite the limited research outputs, indigenous livestock have shown some potential for milk production besides their good performance for adaptive traits. Breed differences, potential of the area for sufficient and quality feed production and availability (direct fodder production, availability Agro-industrial by-products, etc) coupled with proper husbandry practices (proper feeding and breeding) had shown improvements in productivity where the magnitude, due to population size, for increased total production is high.

The challenges in the unsaturated milk and dairy products market (population growth especially urban population) and increases in demand for clean and quality milk paves the opportunity for milk produced at household level to play a key role not only in food security in rural areas but also as the major supplier for the urban population through a market-oriented production system.

Traditional technology in milk preservation and processing has a significant place in the food habits of Ethiopians. The type of butter processed and consumption pattern, though differ from place to place, plays a vital role in supplying high value nutritive milk and dairy products.. Butter making is usually the woman's job - the efficiency of recovery of which affects not only on the out put but also sharing of much of the limited time she has to do all household activities. Understanding traditional processing methods could lead to the formulation of simpler improvements that could produce safe products and make the process more efficient. In this case appropriate technologies such has the Internal Agitator developed by ILCA had proved applicable to increase production as well as reducing the time required to produce butter by 65%. This type of technology is hence practical in the remote areas to decrease the daily drudgery of women, increase household income and reduce post-harvest losses through the utilization of improved technologies.

Different technological interventions (input/services/regulations/controls) appropriate to the varied agro-ecological character and socio-economic situation can be implemented in the country to enhance productivity. With appropriateness of the technology to local needs and its sustainable nature, the effect would have large impact in total yield since it involves large population (large number of households involved with small herd size).

Reviews had indicated that the informal market is dominant in supplying mostly untreated milk, which underlines the need for the pasteurization of milk for safe and healthy use by consumers. Commercial plants could have exploited the situation in expanding processing activities to collect the available milk and processing it to into diverse products. In a situation where this is not advanced in an open market economy and in the absence of subsidized supports to the milk sector, small scale milk marketing and processing units/cooperatives can be expected to grow in the short term.

The Market-oriented approach in dairy development, especially in smallholder dairying has shown a positive result in sustained milk production from improved stock but has also contributed to increased milk output from farms with indigenous cattle. Milk marketing units have indicated the provision of increased returns from milk production through smallscale processing. A small but regular amount of income can significantly improve the livelihood of small scale farmers and their families. However, one of the key requirements to affect this growth as reviewed by Bennett (2001) is the integration of a more business-oriented management..

The development of the Milk Shed approach in dairy development for increased production and subsequent organization of marketing units should be followed as a strategy since it had indicated progress in enhancing productivity. Services could be delivered easily. This could serve as a base for formation of marketing units. Individual milk user groups/co-operatives are still at an infancy stage but there is huge potential in the development of an organized group of milk units either by Wereda, zone or region as unions, which would have the mandate to promote and actively market dairy products and exercise good bargaining power. The union of farmers organizations can be involved in semi-industrial/industrial scale dairy processing and packaging of high value added dairy products.

4. Threats

Milk production in the highlands is considered as a by-product for the production of oxen and hence thrusts in selection of cattle for meat and dairy are secondary. The number of stock per household is

determined by the need to have replacement males for traction and as an asset to avert risks in time of need and natural hazards. To this effect the potential for milk production is not clearly ascertained, though it has been reported as low (1.17kg milk/day, 195 days lactation and 2 years post partum period, delayed first calving) with some opportunities to enhance production through better feeding and breeding practices.

As most of the widely scattered households reside in rural areas (83.2%), the organization of marketing would in short run, be, difficult. This calls for prioritizing potential areas to have good coverage of feasible areas that could be more easily involved in marketing. The topography coupled with under-developed infrastructure and ruggedness of most parts of the country, means that organized milk collection for large scale processing may not be feasible, forcing small scale processing to dominate. This might have some drawback in market development due to the scattered location of these units. Units would also have to operate at a possible low economy of scale and be subject to significant price variations depending on their marketing strategy.

Use of imported technology may not be sustainable due to limited availability, high cost, operational difficulties and maintenance requirements. This been observed in the smallscale milk marketing activities where the milk processing equipment provided was not locally manufactured and spares and maintenance have posed some difficulties for the milk units (particularly separators).

Lack of, or inefficient milk quality testing and lack of active technical support by regulating bodies at collection centers and milk units could result in mismanagement of the milk and delivery of low quality milk which is unhygienic and can lead to low processing efficiency of the plant or units.

IV. The Future

A. The Potential role of small scale dairy farmers and organizations in meeting current and future consumer needs

There is considerable variation in the importance of milk marketing outlets depending on the scale of production and location of producers to marketing centre. Rural areas produce about 85% of the milk (Bennett, A., 20001) where surplus milk is generated especially during the wet season. This milk produced in the smallholder farms is mainly consumed as fresh fermented milk or sold and/or converted to products such as butter, ghee, and cheese for sale (O'Mahonny, 1988). Smallholders are by far the largest in number who produce milk and sell part of their product to consumers. In Addis Abeba milk shed area, for instance, smallholders by supplying 73% of the milk marketed produced the largest amount of marketable milk. From the 6813 small producers identified in 1993 by Addis Abeba Dairy producers Association only 177 are large producers (Staal, et al). When we consider other urban areas the same trend holds true. Milk supplied to urban population is mainly through smallholder dairy farms within the city selling milk on farm-to-door services mostly on contract terms either to households or traders. Most households own cows to produce milk for family needs and or sale as source of income using mostly indigenous breeds. It can then be concluded that the smallholders in all section of the population, urban, peri-urban and rural, are the main actors in the milk supply system of the country.

Smallholder farmers use both formal (exclusively true for the Addis Abeba milk shed area) and informal milk market, the latter dominating in magnitude both for urban and rural outlets. The traditional marketing system and processing technology did not encourage smallholders to increase production. The use of inefficient traditional management practices and resultant products are primarily utilized for home consumption. Farmers sell their produce when they have surplus to their requirements.

Rural milk production can then be significantly increased if access to market can be assured, especially to those farmers who have been involved with introduced technology. To create links between the rural producer and the urban consumer, the development and dissemination of necessary technology and the establishment of infrastructure and organization of farmers to facilitate collection, processing, transport and distribution are indispensable.

On the consumer side, projections in population indicate that there is potential increase in milk demand and that the market for milk is expected to expand in the urban centres and among people with more purchasing power. This increase in demand depends upon the type of product, consumer preferences, and population size, which emphasize that quality, and diversified product types should be considered in the long run.

As has been discussed earlier the formal market is not developing in pace with expected challenges of steady population growth, the need to supply clean and hygienic milk and the need to satisfy increased demand in quality and diversity of the products. Involvement of the private sector in the dairy industry is not encouraging except for a few enterprises set up in Addis Abeba and other urban areas. The involvement of smallscale production and processing and marketing, on the other hand, is emerging on a private and user group/cooperative basis.

In the absence of major improvements in milk collection, processing and distribution, marketing activities may remain stagnant unless some other industry enters the market with an aggressive marketing strategy providing higher returns to farmers for their milk. This may not be practical in the medium term. The role of the smallholder as both the producer and marketing outlet is then much pronounced in the current stage of dairy development. Organization of farmers, as producers and marketing agent of their own product would then be encouraged because its aims are:

- Increasing income of producers by providing steady product outlet.
- Increasing the quantity and quality of milk and dairy products offered for consumers,
- Decreasing reliance on imported products by producing quality and diversified products.
- Safeguard well being of consumers by supplying fresh, hygienic & quality milk & dairy products
- Can assist to follow strict quality control at primary production level involving large but separate entities from production to distribution.

At present small scale dairy farmers and their organization are thriving well in collecting milk from the production area and in processing and distribution of the product in the vicinity of urban areas. The performance of smallscale dairy development had shown positive impact in income and development of the locality where it has been implemented. Abdinasir Ibrahim (2001) in his study to evaluate the adoption rate of dairy development in mixed farming system had indicated that in Lemu Arya and Bilalo area (where Smallscale milk marketing units established by MOA/FAO/WFP and MOA respectively) the average contribution of livestock products to gross farm income of household had increased to 47% of which milk and dairy products had contributed 56%. The milk units had now expanded their activity to collecting from non-members, thus providing market outlet for the resource poor farmers and expanding the domain of processing capacity. Both units process the milk collected to butter, Ayib and sour milk and sale at the Centre and nearby town. Payment to suppliers being determined by the prices of the end product sold at the center had provided increased income to the producer. The significance of the increase over time had been indicated where the average for three years (1995-1997) is 1.47 Birr/Liter as compared to the nearby Weredas (0.75-1.00 Birr). In its effort to function profitably in a sustained manner the role will not be limited to serve as an outlet for milk produced for its members and the populations at large in the area but also serves as quality control media, in the production of diverse products and source of value added income The establishment and functioning of milk marketing institutions run by farmers is encouraging.

Small scale farmers play a vital role in meeting current and future consumer needs as a supplier of nutritious food involving a large population. Because of ease to introduce low cost but efficient and applicable technology, willingness to accept application of appropriate technology, low resource capacity and the desire to overcome poverty, small holders are thus the main actors in reducing post harvest losses and improvement of quality. As they are the primary producers in the milk production chain, adoption of technology has a significant effect in the production system, and minor increases in productivity can significantly affect total production because of the large population and livestock improvement. The association of farmers in rural, peri-urban and urban into marketing group/cooperative at primary, secondary and third level has a cumulative effect in the development of the dairy sector as income generation for the producers and as a reliable source of quality and healthy milk and dairy products for the consumers. As a responsible body for milk collection, processing and product distribution unit, cooperatives have to perform efficiently to compete for their survival and progress, serve as a quality control unit for the public by providing services to their members for clean milk production and quality checking at collection points to receive clean milk for its products. To perform efficiently it has to serve as a steady milk outlet for members as well as non-members to secure high incomes for both the participating farmers and rural society. This will also widen the role they can play in the development of dairying as well as in promoting dairy technology to provide the consumer with sufficient amounts of quality milk and dairy products. The benefits of expanding and underlining the role of smallscale dairy production to the society can then lead to:

- A higher number of producers then will receive increased return from their raw products
- Increase food security, income generation and raised standards of livelihoods in rural areas
- Paves the way for the introduction of more efficient technology
- Reduces transport and spoilage amounts and cost incurred to haul raw milk long distances
- Improvement in quality control of raw milk could be achieved due to scaling up of operation to run profitable business thereby reduce losses and risk of contamination
- Promote organized and efficient milk collection, transportation and distribution system
- Lead to the formation of milk marketing unions and further to Federations, to operate at large economic scale and have better bargaining power in the dairy system dealing with high capacity milk processing where the units will then serve as collection units
- The participation of women in other socio-economic activity will be improved through removal of the burden and drudgery of milk handling at homestead level

B. Strategy for inclusions of the informal sector in dairy sub-sector development

By definition the informal sector include those farmers/dairy farmers and processors who supply liquid milk, directly to consumers on the door-to-door system involving small quantity, mainly without pasteurization, and those that supply and sell dairy products at a wholesale or retail level. This involves smallholder farmers, who use indigenous breeds of cattle, goats, camel and sheep; small scale dairy farmers, smallholders who use improved breeds of cattle; and small and medium scale commercial farms. The characteristics of each of the above milk producers in terms of quantity of milk produced, mode of milk production, the amount of marketable milk, constraints in production enhancement and marketing and the opportunity to develop, differs, which calls for appropriate measures to be taken specific to the needs of each.

Generally, in addressing development needs of dairy farmers, accurate diagnosis of the existing and future constraints facing them is required at dairy animal, agro ecology of the area, farm practices, household resources, type of services available, infrastructure, policy and microenvironment level. Based on the potential of the informal sector in commanding the milk marketing system and the need

to justify sustainable development for the dairy sub-sector emphasis should be given to this sector to address the issue of supplying sufficient and quality milk and dairy product safe for human health. Hence, any development initiated on dairying should then target this sector and focus on technologies relevant to induce changes in productivity.

The strategy to be employed includes organization of the stakeholders in production and marketing, introduction of appropriate technology, expansion of training and awareness creation, introduction of diverse dairy products to suit the needs of consumers in the different income and economy strata, creation of market outlet for the short and long term, recognition of legislation and quality control of milk and dairy products.

1. Organization of production and marketing

The approach followed in attempting to develop a successful dairy development centers around the continuation of a sustainable dairy development within the scope of the country's available resources and is highly dependent on the consistency on the part of the government in adhering to the stated dairy development policy. To this effect dairy development interventions should be focused on potential areas for the production, processing and marketing on a stratification basis.

Organization of the stakeholders into production and marketing units, based on market oriented production system, is essential for sustainable development of the sector. Production units assist in the delivery of government services and creation of self- reliance among producers while marketing units involves in promoting output through milk collection, transportation, processing and distribution.

Proper flow of milk from the rural areas to urban market should be initiated through the formation of smallholder user group/cooperatives to collect, process and distribute. Organization of milk cooperatives at different villages and the formation of these at Unions and Federation levels is essential so as to create a direct link between the producers and consumers thereby, create tangible economic returns and incentives for the farmers and added satisfaction for the consumers. The benefits gained through organizing farmers consist not only of additional income for the producers but also for consumers with regular availability of milk and dairy products. This also creates a forum for the establishment of a body responsible for dairy development and marketing with proper representation of stakeholders.

In organizing farmers under smallholder dairy development “Milk Shed Area” and “Dairy Colony” approach would be used. Under the strategy potential dairy areas of the country will be stratified and prioritized according to potential to give emphasis on those areas with high requirement for whole milk marketing. Considering that dairy potential areas of the country center on main settlement areas where the demand for liquid milk is high with a population growth exceeding production, the peri-urban and rural areas based smallholder dairy development program would be a focus.

The smallholder dairy development strategy will then be focused on setting up of groups of dairy farmers in specific areas with easy access to milk market. The rationale behind the strategy is based on optimum resource management where inputs and services could be concentrated in specific areas where there would be significant impact, rather than scatter scarce resources in a widely diffuse manner over several areas. Strengthened dairy extension services including, veterinary, animal breeding, credit and marketing services would support the colony. The above strategies had been implemented and had proved important during the implementation of DRDP (Bakelo area where the initial colony of 10 farmers had been increased to a 92 member user-group, services and follow up rendered was efficient and had managed to run the milk processing unit).

In developing rural dairying, the smallest size of the Dairy Colony would be determined depending on the scope of the intervention. Usually a colony of not less than ten farmers is envisaged whose number would be increased as more farmers join the club. A single colony or a number of milk colonies could be in a Milk Shed area. Hence a Milk Shed area is a conglomerate of dairy colonies whose whole milk market outlet is a common town. The "user-group" to be involved in milk marketing will be formed with a minimum size of 20 households and the location of each farmer from the furthest member not to exceed 5 Km. The User Group would initially be small in number/size and concentrate its activity on marketing of whole milk or the operation of small-scale milk processing and marketing. The user group would develop their own bylaws and call for full participation in the management and day to day running of the program.

Smallholder milk producers unlike the commercial dairy farmers are more dependent on government services especially in the initial stages of development. It is important that sites are correctly identified and all needed support services are provided for proper implementation of the intervention.

In the process of formation of the milk marketing groups the group can gradually form milk cooperative. The milk marketing co-operative formation must be self- initiated and target group oriented with legal requirements fulfilled with the farmer's cooperative proclamation of 85/86, to have legal entity and right to sue or sued. In this case the Addis Abeba Dairy Producers and Marketing Cooperative, Adaa Liben Milk Marketing Cooperative, Yetigil Fre Milk Marketing Cooperative and others, which are not listed here, are legally operational at different scale of activity and needs to be strengthened to achieve self-development. The Selale Milk Marketing Union is also an indication that there is a room to involve cooperatives further up the line to form a union.

2. Introduction of Appropriate processing technology

Changes in the magnitude of milk marketing will also be accompanied by variations in the composition of milk and the preference of the consuming groups and marketing situation to look for better products. The need to process and market good quality milk and dairy products is of urgent need in order to support and improve the local production by reducing post harvest losses and increasing production and improving product safety for the consumer. Hence, for improved liquid milk marketing to additional urban areas or sale of products, proper methods of processing are required.

i. Use of Indigenous technology

Traditional milk technologies in Ethiopia are based on whole and sour milk, the efficiency and production of diversification of which needs to be evaluated to develop better products that are nutritious, high quality and safe for consumption. Traditional butter making should be improved to minimize losses of nutrients in the whey and increase the efficiency of the processor especially the women by minimizing the time required to recover the butter. This would be carried out in rural areas with provision of improved Internal Agitator locally.

ii. Milk preservation technology

Preservation methods of milk should be employed by improving the traditional technology and introduction of preservation technologies such as Lactoperoxidase (LPS) for the milk destined for liquid milk sale or for processing in by areas within a predetermined time schedule.

iii. Use of Improved Technology

For small scale milk processing where user-groups will be organized to collect milk and process the surplus from sale of whole milk into butter and Ayib and recovered buttermilk, cream separation and butter manufacture units will be required. This approach for dairy development calls for marketing to

be considered as a tool to enhance productivity. Increased production is then compensated with steady and high income as compared to other production systems thus leading market driven technology to flourish. The technology should be improved to increase efficiency in terms of its durability. Introduction of more appropriate and easy to maintain equipment should be sought to reduce problems faced with the present technology. Furthermore, products have to be introduced to compete with imports and to provide increased income to the producer. Considerations in selecting small scale marketing areas will depend on:

- Total volume of milk produced or available
- The distance from the nearest marketing for liquid milk collecting or processing plant
- The relative profitability of selling liquid milk compared to farm processed butter
- Demand fluctuation, particularly due to fasting and lent periods
- Potential of the area for dairying dependent on the agro ecology of the region
- Potential market areas and their population in relation to demand for milk and products

iv. Use of Advanced Technology

In a country where smallholder milk producers dominate, consideration of the marketing system, geographical distribution and scale of operations of the producer, availability of infrastructure and human capacity, a standard milk plant, which should be sturdy enough to be placed in areas and easy to operate and maintain, is vital to select more appropriate technology to be introduced.

In dealing with this kind of situation careful consideration should be given to the choice of the power supply sources in areas which are remote, do not have mains power and there is recurrent power failure, to minimum manpower requirement to sustain training requirements, water requirements both in volume and quality, sustainable milk supply availability, completeness of the system from collection of milk to end product packaging and delivery and diverse products that could be produced.

A mini dairy with a capacity of 1,000-5000 litres per day processing capacity, such as the one developed by Alfa-Laval products or In-pouch pasteurisation plant, Milk-Pro pasteurisation equipment developed in South Africa (Dairy Development Newsletter of March 1998) or any appropriate and applicable dairy processing technology can be recommended. In addition to pasteurisation equipment the plant may include packaging equipment, cheese processing and sour milk product manufacturing capability. For Ethiopian conditions the village milk processing system approach with low cost milk collecting and in-pouch pasteurization system should be considered as best alternative. In areas where the possibilities to sell liquid milk are limited, due to long and difficult transportation, a complete unit with all needed accessories is required. The introduction of the plant makes it possible to better utilize the milk produced in the rural areas and makes it feasible to sell milk in a type of product which is easily marketable or can be transported to urban areas.

3. Establishment of Dairy Technology Training Centre

ILRI is operating a dairy training at its Debre Zeit center, which had exercised demonstration of the technology at continent level in the past 15 years. To date ILRI is catering at international level where use of the center may be constrained by the number of requests and its high cost could not warrant on depending on training of farmers and technicians at a level and capacity the country is requiring. We need to train enough number of technicians and producers to guarantee the supply of dairy technologies for the different sectors involved in dairying. To provide an efficient awareness creation and facilitate training in dairy and provide a network and exchange of information at national level establishment of dairy technology training center is envisaged. Milk being a perishable product it requires special skills in handling, collection, processing, storing and marketing. Development of the manpower requirements for dairy farming, milk plants and intensive training of producers (smallholder farmers and commercial farmers), milk technicians, livestock extension staff, quality control staff, should be supported by introducing more effective institutional training or a training

centre. The duration of the training could be from one month to three months which could be developed later to a more advanced higher skill level depending on demand. The training centre can also be used as a demonstration centre for overall dairy cattle production management for extension officers, dairy co-operatives etc. This training might include basic studies of dairy animal production, milk hygiene, milk quality testing and reception, milk collection, handling and processing and production and manufacture of dairy products marketing and their options, product development and distribution, dairy equipment handling and management skills. The objective is to meet the demand of the dairy processing for qualified staff capable of managing a milk processing enterprise. To speed up the establishment of the centre and to start the training programme and as well to reduce some initial expenditure, it is proposed if the existing infrastructure can be utilized for such purpose. The proposed site is Alage Technical and Vocational Education and Training Centre since it has dairy farm as milk production unit and there are some dormitories and extra buildings near by the dairy farm that can be used for this purpose.

4. Introduction of diverse dairy products

There are a limited number of dairy products, both traditional and imported, available for the consumer to choose from, based on preferences and purchasing power. Traditional products should be improved both in quality and diversity. Introduction of technology to produce diversified products to conserve milk in different forms and improve quality through appropriate technology adopted in the different countries especially in developing tropical countries should be used. Introduction of diverse dairy products to suit the needs of consumers in the different income and economy strata will then be a means to improve marketing and proper utilization of the milk produced as well as augmenting self sufficiency in food of animal origin.

5. Expanding market outlet

Currently the formal marketing is not efficient because of alleged marketing problems for products processed. A number of factors could be sited among which the limited number of products and standards supplied, high price of product and low awareness of the public on quality and importance of milk and dairy products as source of essential food are important. To sustain the performance of milk marketing especially of the processing and product sales a strategy has to be developed in creation of market outlet for the short and long term. Two options are powder milk production and introduction of a school milk feeding system. Product diversification in terms of milk powder production (whole milk, skimmed milk etc.) for long term use in supplying milk in the lean season and times of relief activity should be considered as a priority in milk conservation and the creation of a continuous market in areas where processing units/plants are envisaged. A school milk scheme could also be considered as a means to introduce a sustained market for processing plants in the short term to cater for economic efficiency of the plant. The scheme could assist in developing milk feeding culture among the young and development of health among the vulnerable population.

C. RECOMMENDATIONS TO REDUCE POST HARVEST LOSSES AND IMPROVEMENT OF PRODUCT SAFETY

Milk, unlike most agricultural products contains many essential nutrients such as carbohydrates, proteins, fat, minerals and vitamins that are ideal for rapid multiplication of microorganisms. If it is kept at favorable temperature microorganisms will rapidly multiply. These microorganisms degrade the milk by altering the composition, flavor and keeping quality. To avoid spoilage of milk and dairy products, protective measures from all possible sources of contaminations from the time of milking to final consumption are essential.

From the standpoint of the highly perishable nature of milk, care should be taken from production through consumption including activities during collection, transportation, chilling, processing and distribution to reduce post harvest losses and improve deterioration of quality that can be accrued due to contamination, which is the main source of product lose through rejection for consumption and low efficiency to convert the milk to products during processing. Possible sources of post harvest losses are lack of proper milking procedure, use of improper milking and transporting equipment, losses during storage and transporting through spillage and contamination, lack of market outlet for the produce, low technology level in milk handling and processing absence of quality control and socio economic factors. In addition the following points should be considered in addressing the issue of post harvest losses:

- The scale of contamination during milking and storage affected by temperature and storage time before milk is consumed
- Deliberate adulteration of milk
- Lack of proper handling, transportation and distribution system
- Low level of technology to process milk into acceptable product standards
- Level and lack of fresh milk outlet destined for direct consumption and/or processing
- Spillage losses during milking, storage and transferring
- Unfavorable weather

At farm level clean milk production requires the availability of healthy milk animals with clean resting, feeding and milking sheds, Milk should be handled properly to avoid contamination and lose of quality through proper use of clean utensils and proper handling, keeping away of milk and dairy products from microbial organisms and avoidance of extraneous matter, antibiotics and pesticides residues.

Prompt cooling or chilling of milk at a temperature of 5°C or below is necessary to minimize microbial growth and prevent milk quality deterioration before being processed. In order to facilitate bulking of raw milk supply and transport incoming milk to market centers or stores refrigeration facilities should be installed at village milk collection centers.. In small scale milk production and processing handling of refrigeration or chilling do not warrant other technologies for cooling and keeping the milk at low temperature. In such cases cooling of milk at temperature lower than the revival threshold level of microorganisms must be exercised as much as possible. Technologies such as Lactoperoxidase system can be used. Where development permits large facilities could be used, such as in collection centers.

Adulteration of milk is also a most undesirable act and should be reduced with control measures and awareness creation. Milk sampling equipment and testing kits have to be introduced to effectively control milk quality prior to processing.

Reduction in contamination is of paramount importance for producing, processing and marketing of good quality milk and dairy products. Quality control measures at producer and collection level reduce unnecessary costs of production, time, energy and wastes. This in turn increases the economic returns to the producers while providing clean and safe milk and dairy products to the consumers. This is possible only by implementing a quality code for hygienic milk production, processing, transportation and distribution. Thus, to keep the quality of milk from deteriorating and reduce product losses, measures must be taken to give the prime responsibility for introducing quality consciousness to milk village producers, collecting centers, processors and distributors.

To realize effective quality control and assurance measures in reducing post harvest losses, massive awareness creation programme should be conducted. The programmes should include: basic milk handing conditions, the importance of the use of clean potable water for washing milk vessels, hands, cleaning of the milking areas and the surroundings, milk storage, milk transport at producer's level

etc. At processing and distribution level milk reception, raw milk and product handling and delivery should be emphasized.

Whole milk should be treated before consumption. These may be by boiling the milk at a temperature high enough to kill the pathogenic micro organisms and of a sufficiently short duration to keep the quality of the milk. Pasteurization is the most effective and proven means of minimizing infection risks from raw milk. Other means of milk conservation can be used against reducing contamination and the keeping the quality of milk before consumption of whole milk. For milk consumption by households in areas where pasteurization is not practiced, proper boiling of raw milk should be carried out at a temperature/time combination sufficient to kill pathogenic organisms. However, it should be noted that too high a temperature and an excessively long duration of boiling could deteriorate quality.

Hence, in order to produce clean milk the use of preventive measures is recommended all along the dairy chain. The following points, for instance at the producer level, are critical points at which milk quality improvements can be effected

- Keep the animals clean and disease free:
- Ensure that the place where the animals are kept is clean
- Provide potable drinking water to the animals and cleaning
- Use clean milk utensils for milking and storing
- Wash hands with soap before milking and dry them
- Wash the udder of the animal with clean water and wipe it with dry clean cloth before milking
- Discard one or two streams of foremilk from each teat before milking
- Ensure that the milker is clean, maintains personal hygiene and does not smoke during, before or after milking
- After each milking time, wash the udder with potable water and disinfect
- Keep the milk in a covered utensil
- Keep the milk chilled as far as possible to avoid milk spoilage at lower temperature

In order to supply the consumer with milk, which is clean, sweet, and free from objectable odor and flavor and which does not carry or transmit diseases, proper quality control is essential. This could be achieved if the Government leads the implementation of official controls though legislation and directives and the organization of associated capacities are in place.

The Ethiopian Quality and Standards Authority in collaboration with other stakeholders had prepared a Recommended Code of Practice for General Principles of Food Hygiene, Code of Practice for Pasteurization and handling of milk and Specifications for Whole Milk (pasteurized and fresh whole milk) and for a number of Dairy products.

Hence actions to be taken to minimize losses of milk and dairy products and safeguard the population from health hazards that might be caused by diseases of milk origin, includes the proper setting of legislations on food production, processing and marketing following the WHO/FAO code of practice and use of Hazard Analysis and Critical Control Point (HACCP) system, where identification of cause of risk or hazardous conditions could be done early at every stage in the milk and dairy products manufacturing chain is possible. This would require the support or back up of a food control laboratory capable of a range of milk quality and safety tests. Awareness creation of the public in quality and healthy food products utilization and training of producers, processors and milk and dairy products handlers is also vital in implementation of the safety measures.

The predominant problem of public health related to production processing and retail handling of food of animal origin are of a rather complex nature. An acceptable solution cannot be anticipated unless the specific problems are attacked at all levels of the food chain from its very beginning, from the

raising of animals to the final consumption of foods. The objective of having a food hygiene laboratory is to safeguard consumers from food borne infections and intoxications and to investigate the transmission of the causative agents as well as their epidemiological behavior in agents as well as their epidemiological behavior in humans and animals. The laboratory will take the responsibility for carrying out investigation studies of food borne diseases in the country, give diagnostic services to inspect milk and dairy products and identify different types of food borne diseases in order to assess the microbiological risk of foods, cooperate with national and international authorities in identification of priorities and use of resources to meet both emergency and other needs in the prevention and control of food borne diseases and aware the public (consumers) against fraudulent practices in the food trade and the dangers and risks of food borne infections.

D. IDENTIFICATION OF CRITICAL POINTS IN THE DAIRY CHAIN TO IMPROVE QUALITY AND SAFETY

By definition clean milk is a milk drawn from the udder of healthy animal, which is collected in clean dry milking pail and free from extraneous matters like dust, dirt, flies, hay, manure etc, has a normal composition, posses a natural milk flavor with low bacterial count and safe for human consumption (Sinha, 2000). Changes in milk and its constituents are affected by milking procedure, handling and processing which are dependent on the prevailing storage condition and time as well as temperature. Milk undergoes chemical change during storage through hydrolysis, alcoholic fermentation and acidic fermentation. The growth and proliferation of microorganisms at temperature between 35^0C and 38^0C is high which cause contamination to be accelerated with in short time. Hence milk should be kept for a short duration and at a temperature where microorganisms, especially pathogenic micro organisms, do not have a favorable environment in which to proliferate until the product is consumed. If milk is not produced hygienically it can affect the health of people consuming it. Contamination of milk, besides being a health hazard, can lead to huge economic losses due to deterioration of quality both for direct consumption and processing.

Potential hazards that might cause ill effects such as zoonotic diseases and contamination by microorganisms that cause deterioration of quality should be identified at the different levels of production. Food borne diseases from milk and dairy products are becoming the most widespread public health problems. With increasing incidence, knowledge and awareness of the serous and chronic health effects, emerging food borne pathogens and in increase in the number of vulnerable people cautions to reduce the hazard should be high. The World Health Organization and Food and Agricultural Organization based on Codex Alimentarius, had developed the Hazard Analysis and Critical Control Point System (HACCP) for food safety assurance in food production, processing, manufacturing and preparation to overcome many of the limitations of the traditional approaches to food safety control to reduce the incidence of food borne diseases and ensure safe food supply in the different food production and consumption chains giving emphasis in all stages of the process to be implemented globally. The application of HACCP principles consists of 12 steps following logic Sequences from description of the product, the intended use, the steps used to manufacture the product from production (harvesting) to packaging or distribution for consumption, listing of all potential hazards associated with each step in the manufacturing chain, conduct a hazard analysis and consider any measures to control identified hazards. Determination of critical control points and establishment of critical limits for each Critical Control Points, establishment of a monitoring system for each Critical Control Points, corrective actions, verification process and documentation and record keeping are crucial for the implementation of the procedure.

In the Ethiopian context when dealing with safety of milk and dairy products the type of milk and dairy products that needs to be considered are whole milk consumption (liquid milk, Ititu, Ergo, buttermilk etc) and use of dairy products from fermented processing (butter, ghee, Ayib, Metata Ayib

etc.). . The traditional procedures used to keep it hygienic and processing techniques for each of the products need to be understood well to come up with effective measures or modify or improve the technology to comply with international standards for hygienic, safe and high quality product to be available for the public.

Acceptance of milk safe for consumption initially are based on animal health requirement for healthy milk production, hygiene of the holding, hygiene in milking and keeping of standards to be met for collection of milk from the production for acceptance for treatment, processing and or consumption. Milk should originate from animals free from any disease condition, which do not show any udder wound likely to affect the milk and herd or flock free from officially recognized milk borne disease such as Tuberculosis and Brucellosis.

Contamination of milk can occur at four stages. Theses are contamination at milking, during milk collection and storage (chilling), at transporting and at processing. The more the milk is exposed to contamination (hygienically, temperature and time wise) the high will be the risk to contract harmful microorganisms that cause deleterious effect. Care should be taken at early stages to avoid the hazard where milk needs to be protected from all possible sources of biological, chemical and physical agents especially of microbial contamination and various types of disease causing organisms. The aim for clean milk production should be that it is safe for human consumption and free from disease causing microorganisms, has a high keeping quality and high commercial value. Furthermore it will facilitate milk transportation over long distances and serve as a high quality base product for processing.

1. Care at milking

By avoiding potential sources of contamination at farm level, care in milk handling during milking and subsequent storage before delivery is the first and most important steps in clean milk production. Typically, hygienic farm milk contains less than 100.000 bacteria per ml milk. If milk is left in an unhygienic environment after 24 hours storage the microorganism population would increase with changes in temperature (at 5^0C growth would be 90,000 while at 10^0C to 180,000 and at 15^0C to 4.5 million). . Daily cleaning and disinfection of the premises and all milking equipment is therefore the most decisive factor in controlling the biological quality of milk.

Milk producers should follow hygienic practices during milking and handling of the milk before delivery to consumers, processors or for collection centres. Contamination by external material like feed, dust, mud etc, feeding of animals during milking, presence of smoke and odorous material, adulteration, addition of polluted water are causes of deterioration of milk quality. Contamination of milk by pathogenic microorganisms due to problems with cleanliness combined with high temperature and long duration of stay before consumption or processing will affect milk quality and deterioration leading to a health hazard. The following steps should be considered for clean milk production in extending awareness creation and training of producers.

Shed and milking area

- Use of clean shed to reduce disease condition
- Milk the animal in clean milking area
- Availability of sufficient amount and good quality water for cleansing the utensils and the animal
- Proper drainage of the shed and farmstead

The animal

- Care and management of the animal and its health
- Segregation of animals suffering from contagious diseases
- Washing of the animal regularly particularly udder should be followed

- Milk from diseased animals should be kept separately

Milker and milking

- Milker should be free from contagious diseases
- He/she should be clean when milking.
- He/she should follow good milking routine at consistent milking method and at regular intervals should be drawn directly to the pail as fast as possible to minimize spillage and contamination by bacteria
- Use of sanitary methods during milking
- Examination of fore milk before further milking should also be practiced.

Milking equipment

- Use clean milk storage tanks and containers
- Clean milk storage tanks and containers after use
- Store milk in bulk tanks
- Containers should be clean and kept in dry area
- Traditional milk containers should be stored in cool area to avoid excess temperature

Chilling milk on farm

- Milk leaves the udder at body temperature (37^0c) unless it is chilled it will be spoiled by microorganisms, which thrive and multiply most vigorously at temperatures around 37^0c. It should be chilled to quickly at 4^0c immediately after it leaves the udder.

2. Care at storage and transport

Milking is usually done using any utensil available at the household. There is no dedicated milk pail used nor could its cleanliness be guaranteed. Boiling before consumption, especially for children, is common practice. The rest of the milk would be either sold as whole or some will be accumulated for Ergo or soured for butter making. Equipment used to store milk will usually be washed and smoked which is traditional for cleansing and aroma. However, losses due to contamination and quality deterioration are high. Some of the measures to minimize losses and safeguard the product are:

- Filtering of the milk whenever transferring
- Testing and quality control for chemical composition and hygienic control at delivery
- Cleaning and disinfecting transporting tanks as soon as possible
- Use preservatives like LPS to prolong the time of keeping (possible prolongation of milk are 7-8 hours at 30^0C, 11-12 hours at 25^0C, 16-17 hours at 20^0C and 24-26 hours at 15^0C are reported by Bennett, 2000). Where this is not practiced storing milk in clean container with lid and keeping in cool and shady place will reduce the impact of high temperature and minimize microbial growth
- Transporting should be in clean container
- Transportation should be fast to minimize travel duration impact and agitation
- Violent movement should be avoided

3. Care at milk processing

Whole milk has to be treated to prolonging its shelf life and maintain its quality. In rural areas milk is consumed immediately after milking or boiled to some extent for safe consumption. However, the boiling process can not guarantee safety from hazardous bacteria unless proper temperature and timing is followed to keep its quality and minimize the growth of harmful bacteria. Traditional milk technology for production of butter, Ayib and others, are also prone

to losses and quality deterioration due to low recovery and contamination by bacteria. Health hazards and poor quality resulting from contamination may be due to unclean surfaces of the equipment used for processing, water used to wash and clean the butter, air contamination, packaging material and poor personnel hygiene and cleanliness. To minimize threats, as milk is a dangerous source of infection because it is an ideal medium for microorganisms, milk has to be treated.

- The most treatment that reduces this risk is heat treatment. Pasteurization kills organisms that cause diseases at a correct combination of temperature and holding time capable of removing harmful micro-organisms.

- Milk treatments apart from pasteurization are standardization of the milk, bacteriophage treatment, homogenization and de-aeration, which may be exercised to minimize losses in quality and avoid risk of contamination.
- Care should be taken in cleaning the milk churn and accessories, use of polluted water and packaging material should be avoided and treatment of the product to control bacterial growth should be practiced like salting of butter and heat treatment by boiling of the butter with herds.

4. Support Services

- An effective health service in regular vaccination and health check of animal against contagious diseases
- Collection centers should be set up in strategic areas
- Organize producers to have own milk collection, processing and marketing
- Provide extension and education on importance of cleanliness of the milking environment; clean milk production and animal health care
- Create awareness among the public on clean milk utilization
- Empower women to be involved in milk production, processing and marketing since the milk belongs to them.

5. Milk testing quality control, hygiene and safety

- At farm level there is no direct measurement possible for milk testing and quality control. Indirectly quality can be controlled through checking the sanitary condition of the animals, detect the presence of mastitis, use simple devices to check fat and protein content of the milk produced, check structure for abnormal color and flavor due to ingestion of abnormal feed and screening of milk for residues.

V. RECOMMENDATION AND INTERVENTIONS REQUIRED

Post harvest losses through contamination and degradation of quality can happen at farm level, during milk collection, transportation, processing and marketing. Possible causes are lack of proper milking procedure, use of improper milking and transporting equipment, losses during storage and transporting through spillage and contamination, lack of market outlet for the produce, low level of technology used in milk handling and processing, absence of quality control and socio economic factors. In addressing the issue of post harvest losses and improvement of quality, use of appropriate technology, training and awareness creation of both the producer and consumer and introduction and effective implementation of information platform, legal and institutional measures are thus essential interventions in supplying adequate, safe and quality milk and dairy products to the public at large.

1. Technology transfer

The need to process and market good quality milk and dairy products is of urgent need in order to support and improve the local production by reducing post harvest losses and increased production and safety of the consumer. Hence to improve liquid milk marketing in additional urban areas and enable sale of products, proper methods of preservation and processing are required.

Use of improved Indigenous butter making technology

Traditional milk technologies in Ethiopia are based on whole and sour milk, the efficiency and product diversification of which needs to be evaluated to develop better products that are of a high quality and safe for consumption. Traditional butter making should be improved to minimize losses of fat in the whey and increase the efficiency of the processor especially the women by minimizing the time required to recover the butter. The Internal Agitator developed by ILCA may be considered as an applicable technology. Other technologies should be sought from countries with similar traditions.

Milk preservation technology

Preservation methods of milk should be employed such as improving the traditional technology and introduction of natural preservation such as the Lactoperoxidase system (LPS) for the milk destined for liquid milk sale or for further processing in specific locations with a pre determined time schedule.

Use of Improved Technology

As milk marketing is the main constraint in rural milk producing areas market oriented dairy development calls for introduction of alternative technologies to be employed. Thus the use of small scale milk processing as a tool to enhance productivity should be considered where user-groups would be organized to collect milk and process the surplus from sale of whole milk into butter, Ayib and other products. The recovery of buttermilk, cream separation and butter manufacture units will be required. The present technology used should be improved to increase its efficiency in terms of its durability. Introduction of more appropriate and easy to maintain equipment should be sought to reduce difficulties facing using the present technology. Further, more products have to be introduced to compete with imports and provide increased income to the producer.

Use of Advanced Technology

With a few exceptions in peri-urban areas, smallholder milk producers dominate the marketing system. These producers are found scattered over a wide geographical area and their scale of operations is small. This situation combined with inadequate infrastructure makes it complex to consider implementing a standard milk processing technology.. In promoting milk processing in rural areas comparative advantage both as a raw milk outlet for the producer and as supplier of good quality milk and dairy products for the consumer should be considered. Selection of low cost processing plants with designs to suit the existing situation and flexible enough to allow changes in resource utilization for efficient product output is also an important factor to consider for advanced but appropriate technology. A mini dairy with a capacity of 1,000-5000 litres per day processing capacity, such as the one developed by Alfa-Laval products or the In-pouch pasteurisation plant, Milk-Pro pasteurisation equipment developed in South Africa (Dairy Development Newsletter of March 1998) or any appropriate and applicable dairy processing technology can be recommended. In areas where the possibilities to sell liquid milk are limited,

due to long and difficult transportation, cottage industries for the production of butter and other dairy products can be considered. Exploring of low cost product processing and packaging alternatives should continue to develop with proper technology that is efficient and applicable to smallholder conditions and needs.

Introduction diverse dairy products

There are a limited number of dairy products available for the consumer to choose from, based on preference and purchasing power. Traditional products should be improved both in quality and variety. The introduction of technology to produce diversified products to conserve milk in different forms and improve quality through appropriate technology adopted in various countries, especially in developing tropical countries, should be used. Introduction of diverse dairy products to suit the needs of consumers in different income and economic strata will then be a means to improve marketing and proper utilization of the milk produced as well as augmenting self sufficiency in food of animal origin.

2. Training and awareness creation

Post harvest losses and quality deterioration can be attributed to the scale of contamination during milking and storage which is affected by temperature and storage time before milk is consumed, deliberate adulteration of milk, lack of proper handling, transportation and distribution system, low level of technology for processing milk to acceptable product standards, level of and lack of a fresh milk outlet destined for direct consumption and/or processing, spillage losses during milking, storage and transferring and unfavorable weather conditions. To minimize potential losses, eliminate contamination and prevent zoonotic diseases, proper milk treatment and handling are essential and thus training of producers, milk handlers and consumers is essential. Training should be carried out at various levels to create a harmoniously operating system at farm level, at collection and sale of whole raw milk, at collection and processing and milk handling during distribution and at home.

Training and awareness creation could be on subjects related to the introduction to modern dairying, hygienic milk collection, transportation and handling, quality control, potential sources of contamination and cleanliness procedure, milk storage and pasteurization, orientation on milk and dairy products, use of proper milk containers, how to maintain milk quality, etc. To reduce potential losses, training in milk technology and an introduction to improved, applicable and efficient dairy technology and processes is vital. Training of farmers, processors and distributors can be carried through informal hands-on tailor made training programmes on specific issues mainly through short term education, production of manuals and distribution of educational materials. Training and awareness creation can be carried out at the following levels:

- Farmers level – as producers of raw-whole milk destined for home consumption, perform home processing traditionally and delivery of whole milk to consumers and processors
- Smallholder user-group level – as organized milk collectors and processors serving rural households and producing products at small scale technology
- Small scale dairy processors level – urban and peri-urban milk producers cum processors of butter, Ayib and cheese
- Milk and dairy product collectors and retailers level – milk and dairy product haulers, retailers from house-to-house, milk kiosks, milk/coffee shops,
- Milk processing level – processors and training institutions (on general quality control and code of practice)
- Consumer level - the general public (on value of milk and quality and safe milk utilization)

Awareness creation for the public at large on the utilization and benefit of quality milk and dairy products is vital to narrow the information gap. This involves the introduction of milk and dairy

products as an important source of food, what affects its availability and safety and on clean milk utilization In this respect media, pamphlets and education materials can be used to educate consumers on benefits of quality milk and dairy products.

Establishment of Dairy Technology Training Centre

The need to train a sufficient number of technicians and producers to guarantee the supply of dairy technologies for the different sectors involved in dairying and to provide an efficient awareness creation and facilitate training in dairy and provide a network and exchange of information at national level establishment of dairy technology training center is envisaged. The training could be from one month to three months, which could be developed later to a higher skill level depending on demand. The training centre could also be used as a demonstration unit for overall dairy cattle production and management for extension officers, dairy co-operatives etc. The training might include basic studies on dairy animal production, milk hygiene, milk quality testing and reception and processing. It will deal with the manufacture of dairy products, marketing, product development and distribution, dairy equipment handling and management skills. To speed up the establishment of the centre as well as to reduce some initial expenditure, it is proposed that an existing infrastructure be utilized for such this purpose. The proposed site is Alage Technical and Vocational Education and Training Centre 200 km south of Addis Abeba. It has a dairy farm, a milk production unit and there are some dormitories and extra buildings nearby the dairy farm, which that can be used for training purposes.

3. Information platform

The availability of an information system dealing with the development of dairy commodities, milk production and productivity, milk and dairy products standards and quality control, consumption patterns (demand and supply) and marketing networking between researchers, producers, consumers and policy makers is vital if proper and steady dairy development is expected in the country.

Thus the establishment of a good information system is central to the development of dairying.
In this regard the following should be addressed in the establishment of information platform.

- Development of accurate statistics on livestock and dairying
- Identification of sources of information
- Set up a dairy information system in the appropriate organization through formation of documentation system and electronic media.
- Conduct periodic market survey
- Link required information system with the pilot National Agricultural Information System

4. Other Considerations

Expanding market outlet

Currently the formal marketing is not efficient because of marketing problems for processed products associated with the limited number of products supplied and their standard, high product price and low awareness of the public on quality and the importance of milk and dairy products as a source of essential food. To sustain the performance of milk marketing especially of the processing and product sales a strategy has to be developed to creation a market outlet for the short and long term. The two options available are powder milk production and the introduction of a school milk feeding programme. Product diversification in terms of milk powder production (whole milk, skimmed milk etc.) for long term use in supplying milk during lean season and in times of relief activity, should be considered as a priority in milk conservation and creation of a continuous market in areas where processing units/plants are envisaged. A school milk scheme could also be considered as a means to

introduce a sustained market for processing plants in the short term and in the long term the scheme could assist in developing an increased milk consumption culture among the young and improve the health and nutritional levels of the vulnerable population.

Organization of farmers on production, processing and marketing

Organization of dairy farmers into production and marketing units, based on a market-oriented production system, is essential for the sustainable development of the sector. Production units could assist in the delivery of government services and creation of self- reliance among producers while marketing units could be involved in promoting output through milk collection, transportation processing and distribution. Establishment of farmer's organizations in milk production, milk collection and small scale milk processing and registration and licensing of these with acceptable minimum requirement could assist in promoting milk production and utilization, in providing services in marketing, serving as a forum for promoting quality control and act as a quality testing facility, assist in promoting training and serve as a collective action media for procurement of goods and services.

Support services

Support services for both Government and public should be strengthened to enhance milk production and promote milk and dairy products utilization. The following interventions should be considered as important steps in promoting dairying:

- An effective health service in regular vaccination and health check of animal against contagious diseases
- Set up collection centers at strategic areas
- Provide extension and education on importance of cleanliness of the milking environment; clean milk production and animal health care
- Empower women to be involved in milk production, processing and marketing.
- Milk testing quality control, hygiene and safety
- Implementation standards and legislations on milk quality and assurance

REFERENCES

- Azage Tegegne and Alemu G/Wold, 1997, Prospects of Peri-Urban Dairy Development in Ethiopia, In Proceedings of the Fifth National Conference of The Ethiopian Society of Animal Production, Addis Abeba Ethiopia
- Belachew H., 1994, Dairy Products Marketing Survey of Addis Abeba, MOA/DDE, Ethiopia
- Belachew H., 1998, Milk Sales Outlet Options in Addis Abeba and the Surrounding Peri-Urban Areas: In Proceedings of The Fifth National Conference of ESAP, May 1997, Addis Ababa
- Bennett, 2000, The Lactoperoxidase system (LP-s) of milk preservation, in Report on the FAO E-mail conference on small scale milk collection and processing in Developing countries.
- Bennett, A., 2001, Milk marketing Study, Smallholder Dairy Development Project, Addis Abeba
- Berhanu Bedane, 1999. Consultancy Report on National Veterinary Policy. MOA, Addis Ababa,
- Brannang E. and S. Persson, 1990, Ethiopian Animal Husbandry- A Hand Book, Addis Ababa, Ethiopia
- Coppock, D.L., 1994, The Borana Plateau of Southern Ethiopia, Synopsis of Pastoral Research, Development and Change (1980-1991), International Livestock Centre For Africa, Addis Ababa, International Livestock Centre For Africa, Addis Ababa, Ethiopia.
- CSA, 1998, Ethiopian Statistical Abstract, Central Statistical Authority, Addis Ababa, Ethiopia
- DDE, 1982, Finland Government Assistance for Dairy Development, Dairy development Enterprise, Addis Ababa, Ethiopia.
- Debrah S. and Anteneh B., 1991, Dairy Marketing in Ethiopia: Markets of First Sale and Producers' Marketing Pattern, ILCA Research Report No 19. International Livestock Centre For Africa, Addis Ababa, Ethiopia.
- FAO, 1999, Production Year Book 1998, Food and Agriculture Organization, Rome Italy
- FAO/ADB, 1998, National Livestock Development Programme preparation report-Ethiopia, Rome
- Getachew Felleke and Gashaw Geda, 2001, The Ethiopian Dairy Development, A Draft Policy Document, MOA/FAO, Addis Abeba, Ethiopia.
- Getachew Felleke and Tesfaye Chernet, 2000, Economic Advantages of Jersey and other Cattle Breeds Utilization in the Mid and High Altitude Areas, Ministry of Agriculture, Addis Ababa,
- Getachew Felleke, 1999, Smallholder Dairy Development and Sustainable Land Use, Paper Presented on Workshop on Sustainable Land Use, NOVIB Partners Forum, Addis Abeba
- Giangiacomo, R. Milk testing, quality control, hygiene and safety, (FAO)
- Holden, S. J. and Coppock D. L., 1992, Effects of Distance to Market, Season and Family Wealth on Pastoral Dairy Marketing in Ethiopia, Journal of Arid Environments
- ILCA, 1993, Handbook of African Livestock Statistics. Working Document No. 15, International Livestock Centre For Africa Addis Abeba, Ethiopia
- ILCA, 1995, Livestock Development Strategies for Low Income Countries, International Livestock Centre for Africa, Addis Abeba, Ethiopia
- ILRI, 2000, Handbook of Livestock Statistics for Developing Countries International Livestock Research Institute, Nairobi, Kenya
- Jahnke, H.E., and Getachew A. 1986, An Assessment of the Recent, Past And Present Livestock Situation in the Ethiopian Highlands, Ethiopian Highland Reclamation Study, LUPRD, MOA,
- Kiwuwa, G.H., J.S.M. Trail, M.Y. Kurtu, G Worku, F.M. Anderson and J Durkin, 1987, Crossbred Dairy Cattle Productivity in Arsi Region, International Livestock Centre for Africa, Addis Abeba,
- Knoess, K.H., 1997, the camel as a milk and meat animal, World Animal Review.
- Mekasha, Yosef, 1999, Impact of feed resources on productive and reproductive performance of dairy cows in urban and peri-urban dairy production system in the Addis Abeba milk shed and evaluation of non-conventional feed resources using sheep, MA thesis submitted to Alemaya University of Agriculture.
- Mesfin Tesfaye and Getachew Felleke, 1991, Dairy Development in Ethiopia, Working Paper II, Ministry of Agriculture, Addis Ababa, Ethiopia

- Mesfin Tesfaye, Getachew Felleke, Beruk Yemane and Mesfin Alemu, 1991, Dairy Development in Ethiopia, Working Paper I, Ministry of Agriculture. Addis Ababa, Ethiopia
- Ministry of Agriculture, 1993, Livestock Sector Development Project, 1993
- MOA, 1975, Report on Status of private dairy farms in Awrajas in the periphery of Addis Abeba after the rural land proclamation of 1974 (in Amharic), Addis Ababa, Ethiopia
- MOA, 1982, Ten Year Perspective Development Plan 1983/84-1992/93 Vol. II. Ministry of Agriculture (In Amharic) Addis Ababa, Ethiopia
- MOA, 1985 Dairy Rehabilitation and Development Project, Project Completion Report Ministry of Agriculture. Addis Ababa, Ethiopia
- MOA, 1985, Livestock Sub Sector Review, Volume III, AACM, Addis Ababa
- MOA, 1985_2 Dairy Rehabilitation and Development Project, Project Preparation Document, Annexes Vol II, AACM, Ministry of Agriculture Addis Ababa, Ethiopia
- MOA, 1992, Draft Dairy Development Policy Ministry of Agriculture (in Amharic) Addis Ababa,
- MOA, 1994, Selale Peasant Dairy Development Project, Project Completion Report, Addis Ababa, MOA, 1994, Smallholder Dairy Development Project, 1994 Ministry of Agriculture Addis Ababa,
- MOA, 1996, Report of milk and milk products market Survey, 1990/92, MoA/AFRDMA)
- MOA, 1996, Ruminant Livestock Development Strategy, Ministry of Agriculture
- MOA, 1997, National Livestock Development Programme, Ministry of Agriculture Addis Ababa,
- MOA, 2000, Second Five Year National Livestock Development Plan of Federal Democratic Republic of Ethiopia, (in Amharic) Ministry of Agriculture Addis Ababa, Ethiopia,
- MOA, 2000, the long term Development Plan to Infrastructure and Agriculture, Addis Abeba.
- Mukassa-Mugerewa, E, 1989, A Review of Reproductive Performance of Female Bos indicus Cattle, ILDA, Addis Ababa, Ethiopia
- O'Mahony, 1995, Rural Dairy Technology, ILCA Addis Ababa, Ethiopia
- Sansoucy R., M. A. Jabbar, S. Ehui, H. Fitzhugh, The Contribution of Livestock to Food Security and Sustainable Development. In Proceedings of the Joint FAO/ILRI Roundtable on Livestock Development Strategy for Low Income Countries, ILRI, Nairobi, 1995.
- Sinha, O.P. Clean milk production and Support Services, Report on the FAO E-mail conference on small scale milk collection and processing in Developing countries. July 2000).
- Solomon Desta, 2000, Pastoralism and Natural Resources Management: the case of pastoral Borana in southern Ethiopia, in proceedings of the 8th ESAP Annual conference, Addis Abeba
- Staal S. J., 1992, Livestock Policy Comparisons in Peri-Urban Dairy Systems Surrounding Nairobi, Kenya and Addis Abeba, International Livestock Centre for Africa Ethiopia.
- Staal S.J., et al, 1997, Smallholder Dairying under Transaction Costs In Africa, 1997 International Livestock Centre for Africa Addis Ababa, Ethiopia
- Staal, S.J. And Shapiro, B.I., 1996. The Economic Impact of Public Policy on Smallholder Peri-Urban Dairy Producer in and Around Addis Ababa. In ESAP Publication No2. Ethiopian Society of Animal Production, Addis Ababa, Ethiopia.
- Titarelli, F., 1990, Smallholder Dairy Marketing Pattern in the Central Ethiopian Highlands in Selale Awraja, A Case Study International Livestock Centre for Africa, Addis Ababa
- UNDP/Ministry of Agriculture, 1993, Food Production, Food Security and Nutrition, In Agricultural Production Technology Sub Programme II, Ministry of Agriculture Addis Ababa, Ethiopia
- Zegeye Yigezu, 1998. DDE's Experience in Milk Collection, Processing and Marketing, In Proceedings of the Role of Village Dairy co-operatives in Dairy Development, Ministry of Agriculture Addis Ababa.
- Zelalem Yilma and Ledin I., 2000, Efficiency of stallholder butter making in the Ethiopian Highlands in Proceedings of the 8th Annual Conference of the Ethiopian Society of Animal Production, Ethiopia.

Annex 1: Import of milk and Dairy products from 1988/89-1997/98

Year	Milk and dairy products		Butter, Cheese	
	Commodity (Ton)	Value (Birr)	Commodity (Ton)	Value (Birr)
1988/1989	4,472.095	12,637,513	75.071	196,665
1989/1990	10,968.490	17,895,360	157.705	184,560
1990/1991	269.303	2,219,505	29.112	110,398
1991/1992	216.531	5,126,658	13.653	182,375
1992/1993	1,485.614	11,485,956	49.880	118,399
1993/1994	169.618	2,421,107	261.260	133,680
1994/1995	852.963	3,025,394	116.466	420,865
1995/1996	319.314	5,634,152	50.522	443,435
1996/1997	544.328	6,610,354	270.745	912,900
1997/1998	457.260	124,180,568	370.376	1,529,543

Source: Ethiopian Customs Authority, 2003

Annex 2: Annual milk utilization by the Addis Abeba milk processing plant (1991-2000)

Year	Milk collection		Powder Milk utilized	Total
	Own farm	Farmers		
1991	3,366,963	2,498,544	1,640,500	7,506,007
1992	1,373,927	1,334,575	2,708,547	5,417,049
1993	1,002,960	1,171,433	450,760	2,625,153
1994	1,396,564	2,407,380	139,000	3,942,944
1995	2,159,000	2,471,836	150,000	4,780,836
1996	2,556,654	2,399,968	48,200	5,004,822
1997	2,351,643	2,116,793	129,060	4,597,496
1998	2,502,550	2,076,779	NU	4,579,329
1999	2,234,730	2,065,824	NU	4,300,554
2000	1,782,755	2,501,790	NU	4,284,545
Total	20,727,746	21,044,922	5,266,067	47,038,735
Average	2,072,775	2,104,492	752,295	4,703,874

Source: Zegeye, 1999; NB Milk powder was not utilized since 1997

Annex 3: Annual processing capacity of the Addis Abeba milk processing plant (1991-2000)

Year	Pasteurized (Ltrs)	Butter (Kg)	Ayib (Kg)	Cheese (Kg)	Yogurt (Kg)
1991	7,614,740	87,609	47,891	5,274	8,830
1992	4,075,352	33,459	18,603	NA	9,380
1993	2,403,155	27,972	51,363	1,065	NA
1994	3,037,265	68,063	97,369	3,739	41,356
1995	4,277,508	81,200	45,618	5,525	55,229
1996	4,522,935	95,659	30,754	5,239	NA
1997	4,223,352	72,280	33,616	12,675	200
1998	4,244,662	77,777	27,342	14,835	
1999	3,994,142	66,575	39,999	11,466	
2000	3,906,193	64,277	50,651	11,240	
2001	3,878,148	62,280	88,027	9,469	
Total	42,299,304	674,871	443,206	71,058	114,995
Average	4,229,930	67,487	44,321	7,895	22,999

Source Zegeye, 1999

Annex 4: Projected Population by age group

	2000	2005	2010	2015	2020	2025
Total Population						
0-4	11,155,720	12,833,831	14,667,963	16,608,218	18,624,551	20,659,860
4-14	16,673,262	19,181,354	21,922,636	24,822,528	27,836,125	30,878,084
15-19	7,060,422	8,122,493	9,283,310	10,511,291	11,787,422	13,075,563
20-34	14,704,979	16,916,990	19,334,663	21,892,222	24,550,063	27,232,918
35-54	9,555,697	10,993,122	12,564,192	14,226,163	15,953,301	17,696,693
55-59	3,180,999	3,659,504	4,182,498	4,735,753	5,310,700	5,891,059
>59	1,161,922	1,336,705	1,527,739	1,729,826	1,939,837	2,151,824
	63,493,000	73,044,000	83,483,000	94,526,000	106,002,000	117,586,000
Rural Population						
0-4	8,319,388	9,450,826	10,646,328	11,865,238	13,078,604	14,235,606
4-14	16,854,864	19,147,128	21,569,184	24,038,664	26,496,912	28,840,968
15-19	5,888,398	6,689,221	7,535,388	8,398,123	9,256,934	10,075,851
20-34	10,804,400	12,273,800	13,826,400	15,409,400	16,985,200	18,487,800
35-54	8,373,410	9,512,195	10,715,460	11,942,285	13,163,530	14,328,045
55-59	2,593,056	2,945,712	3,318,336	3,698,256	4,076,448	4,437,072
>59	1,188,484	1,350,118	1,520,904	1,695,034	1,868,372	2,033,658
	54,022,000	61,369,000	69,132,000	77,047,000	84,926,000	92,439,000
Urban Population						
0-4	1,022,868	1,260,900	1,549,908	1,887,732	2,276,208	2,715,876
4-14	2,576,112	3,175,600	3,903,472	4,754,288	5,732,672	6,839,984
15-19	1,325,940	1,634,500	2,009,140	2,447,060	2,950,640	3,520,580
20-34	2,434,047	3,000,475	3,688,207	4,492,103	5,416,532	6,462,779
35-54	1,505,889	1,856,325	2,281,809	2,779,161	3,351,084	3,998,373
55-59	416,724	513,700	631,444	769,076	927,344	1,106,468
>59	189,420	233,500	287,020	349,580	421,520	502,940
	9,471,000	11,675,000	14,351,000	17,479,000	21,076,000	25,147,000

Source: Getachew Felleke and Gashaw G, 2001

Annex 5: Estimate of livestock population

YEAR	POPULATION				TLU (Including equine)
	CATTLE	SHEEP	GOATS	CAMEL	
1995	33,003,907	23,386,251	17,369,321	1,119,112	33,909,086
1996	33,399,954	23,409,637	17,378,006	1,128,065	34,213,653
1997	33,800,753	23,433,047	17,386,695	1,137,089	34,521,794
1998	34,206,362	23,456,480	17,395,388	1,146,186	34,833,554
1999	34,616,839	23,479,936	17,404,086	1,155,356	35,148,976
2000	35,032,241	23,503,416	17,412,788	1,164,598	35,468,101
2001	35,452,628	23,526,920	17,421,494	1,173,915	35,790,975
2002	35,878,059	23,550,447	17,430,205	1,183,307	36,117,643
2003	36,308,596	23,573,997	17,438,920	1,192,773	36,448,148
2004	36,744,299	23,597,571	17,447,640	1,202,315	36,782,537
2005	37,185,231	23,621,169	17,456,363	1,211,934	37,120,857
2006	37,631,453	23,644,790	17,465,092	1,221,629	37,463,152
2007	38,083,031	23,668,435	17,473,824	1,231,402	37,809,473
2008	38,540,027	23,692,103	17,482,561	1,241,253	38,159,865
2009	39,002,508	23,715,795	17,491,302	1,251,183	38,514,379
2010	39,470,538	23,739,511	17,500,048	1,261,193	38,873,063
2011	39,944,184	23,763,250	17,508,798	1,271,283	39,235,965
2012	40,423,514	23,787,014	17,517,552	1,281,453	39,603,136
2013	40,908,596	23,810,801	17,526,311	1,291,704	39,974,627
2014	41,399,500	23,834,611	17,535,074	1,302,038	40,350,491
2015	41,896,294	23,858,446	17,543,842	1,312,454	40,730,778
2016	42,399,049	23,882,305	17,552,614	1,322,954	41,115,541
2017	42,907,838	23,906,187	17,561,390	1,333,538	41,504,835
2018	43,422,732	23,930,093	17,570,171	1,344,206	41,898,711
2019	43,943,805	23,954,023	17,578,956	1,354,960	42,297,226
2020	44,471,130	23,977,977	17,587,745	1,365,799	42,700,432
2021	45,004,784	24,001,955	17,596,539	1,376,725	43,108,389
2022	45,544,841	24,025,957	17,605,337	1,387,739	43,521,152
2023	46,091,379	24,049,983	17,614,140	1,398,841	43,938,777
2024	46,644,476	24,074,033	17,622,947	1,410,032	44,361,324
2025	47,204,209	24,098,107	17,631,758	1,421,312	44,788,849

Source: Getachew Felleke and Gashaw G, 2001